The Dock & Harbour Authority

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Editorial Notes

Harbour Developments at Barbados

Barbados, the most easterly of the West India Islands, has an area of 166 square miles. Its capital and port is Bridgetown, with an estimated population of 18,000, on the shores of an open roadstead, Carlisle Bay. Its economy is based almost entirely on the sugar cane and exports of rum, molasses and 150,000 tons annually of refined sugar provide its main subsistence. Sugar growers from all over the Caribbean come to study problems in cultivation and cane selection in the Sugar Experimental Station. But there are limits to what efficiency can do, particularly with a low-value commodity where handling and transport—an element of production costs—may be disproportionately high. Sugar, however, is not a crop which can be looked on to sustain one thousand five hundred people to the square mile.

The port development work described in an article in this issue clearly revolves around the sugar industry. A capital investment of some £4 million on such a narrow base must connote some measure of subsidy, for in the strictest sense it would not appear to be economically viable. The authorities, no doubt rightly, have concluded that assistance in this form is greatly to be preferred, for the asset provided can be usefully employed in promoting other sectors of the economy, of which the tourist industry is perhaps the most promising. Hitherto the awkwardness of embarking and disembarking in an open roadstead has proved something of a discouragement. The new West Indies Federation has of course offered greater opportunities for mutual trade among the smaller islands and more freedom of movement. The better means of communication which are now provided must all be looked at in that context.

As for the main construction, this follows a sound and conservative pattern—a model of orthodoxy, in fact—with heavy blockwork both in breakwaters and quays. Although much interesting detail is given, a key plan and typical sections of breakwater construction would greatly have helped an appreciation of the factors influencing the design. More particularly, a general arrangement of the bulk-loading installations, which are immensely complicated in description, would have been most valuable in following the different movements. This equipment is of a very advanced design. Perhaps its most interesting feature is in the use which is made of throwers for distributing the sugar. For stockpiling a thrower is incorporated in the plough or trip gear traversing the length of the main high-level feed conveyor. For distributing sugar into the ends and corners of the hatch, throwers are embodied in the outlets of the ship-loading chutes, though these may be by-passed when there is no occasion for their use. All hatches of a vessel can be covered from three fixed outlet towers, without the need for hauling or trimming. Throwers are, of course, largely employed for trimming granular material in ships' holds and for feeding into high stockpiles, but these usually take the form of hopper-fed portable units. Introducing them " in line " as is done in this installation is a noteworthy advance in the bulk conveying of such material.

Sugar is an awkward material. Its free-running properties cannot always be relied upon, particularly in hot climates, when stored in mass. Elaborate precautions have therefore to be taken to enable stockpile material to be re-circulated round the system and measures adopted for removing coagulation on belts. Even so, a high stockpile may not always feed regularly on to a delivery belt so that stand-by mechanical shovels are often provided, as here, in the event of troublesome compaction occurring.

The Design of Wharf Fendering

Suitable fendering systems for quay structures have always presented difficult problems of design. High energy absorption to provide protection against heavy impact and soft, low inertia springing to reduce wave-generated oscillation of vessels moored alongside are conflicting requirements which are virtually impossible to reconcile in one system. With large vessels in well sheltered harbours, however, the second requisite is not usually an exacting one, but in the case of tankers, for example, where berths may be rather exposed and subject more often than not to wide tidal variation, it assumes a high importance. Fortunately, the form of quay, whether of solid or open construction, appears to have little effect on movement due to beam-on waves, otherwise another awkward dilemma would present itself. Then again, a system which is suitable for the large vessel will by its very robustness be incapable of accommodating itself to the rapid oscillation of small ships, harbour craft and the like, which can often be more destructive of fendering than are the sea-going ships. Even so, the grinding action of clusters of rivets at lap joints and doublers can become a costly nuisance, but this is as nothing compared with the damaging effect of a baffle box over an overside discharge pipe. Happily, these excrescences are becoming less frequent.

It is an immensely complicated matter to compute the actual energy of impact for a vessel approaching a quay. Whereas it may reasonably be taken as a function of the square of the velocity (though a lower exponential probably applies with the

small velocities in question), it is not the displacement of the vessel which has to be considered but its "virtual mass," as a floating object setting in motion water which increases its inertia, and this is a function of the vessel's underwater body form in the direction of its motion—its wave-making resistance, in fact. According to classical hydrodynamics the coefficient would be unity for an immersed sphere and 0.5 for a floating semi-cylinder moving sideways. For most practical purposes, however, the mass of approach can be taken as somewhere between 0.4 and 0.5 of a vessel's displacement with a maximum velocity of about 0.5 ft/sec. The energy to be absorbed is thus dependent on velocity, displacement and on the direction of motion, and is greatest for a lateral movement, though longitudinal movement may be more damaging because of its local effect.

The contribution of the rubber manufacturing industry towards a solution of these abstruse problems, surely one of the most significant developments in this direction in recent years, is described in an article we print in this issue. For rubber, now available in heavy tubular and cylindrical sections, and bonded to steel for absorbing torsional strain energy, has almost the ideal properties required by a fendering system whether it is used wholly elastically or in combination with gravitational devices. It is resistant to scuffing and abrasion and, when kept damp and shielded from strong sunlight, it is extremely durable. The latest application, using oversize tyres (developed for earth-moving equipment) freely rotating on a spindle as an improved version of the camel fender, is not without interest. Deep cushion tyres rigidly secured to a round spar have previously been used in this way, but the pneumatic tyre employed in such a role is surely quite original. Further experiment in different conditions will of course be needed to establish its practical value; not only is it subjected to unpredictable loading but the manner of its loading is quite different from that for which it is primarily designed. A different form of test will be needed to establish what diametrically-applied dynamic load a standard tyre can reliably withstand with a suitably adjusted air pressure.

In designing a fender system a wharf engineer may perhaps be excused for assuming that the purpose of a fender is to protect the wharf. Likewise it may be natural for the shipowner to regard the fender as a means of protecting his ship which, functionally is unable to protect itself. Either is vulnerable to impact loading, an open-structure quay particularly so, apart from considerations of its overall stability. Any controversy of this sort is, of course, sterile. A well-designed fender system cannot help protecting both—with this exception: it is a practical impossibility for it to adapt itself to the rapid movement of small craft, which must necessarily provide their own protection (as they are well able to do) not only against the wharf but against other vessels of their kind. It is a duty of a wharf owner to provide a safe berth for vessels which come alongside as invitees. It is likewise the duty of the ship to come alongside in a careful and circumspect manner and it can be held responsible in the first instance for damage which may be caused on its part by any untoward happening. With the unpredictability of tide and weather and a host of other factors operating, by no means does this invariably connote negligence.

Packaging and Cargo Handling

Everyone knows that where there is sufficient traffic in a commodity, with long runs of cargo of uniform size, specially adapted equipment can be brought into use which can greatly simplify the handling processes. Unfortunately, these conditions are rarely encountered in the liner trades. More often than not the traffic moves in relatively small bill of lading lots in endless variety of shape, size and style of packing, sometimes substantial, sometimes quite the reverse, and frequently with extremely exiguous protection or none at all. It is to be expected that exporters with long experience of a particular trade will have discovered by trial and error what form of protection is best suited to their goods, but the variety, and range of goods is constantly widening. It is everyone's aim to open up new export markets. The cost of packaging (as with everything else) is ever increasing and economies in this and that direction are a compelling necessity.

This is a subject which we have touched upon earlier in this Journal following interesting comment in our correspondence columns, but the emphasis then was placed on the fixing of responsibility for damage to goods caused either through negligence or through the particular exigencies of cargo working. The article we print in this issue, which forms part of a symposium on general working methods conducted by I.C.H.C.A. at its congress in Antwerp last year, discusses the impact of packaging on cargo handling as a factor largely determining the nature of those exigencies.

During the past decade so much attention has been devoted to the carriage and handling of goods on dry land using labour-aiding equipment ("the best way to handle goods is not to handle them at all") that it is sometimes overlooked that these admirable sentiments have little relevance in the confines of a ship's hold where work is still, essentially, a manual operation which might even be made more laborious by sophisticated working methods on the shore. For apart from some minor refinements work in this quarter remains substantially the same as it did a century ago, although under-deck spaces are larger and cargo is infinitely more variegated. Except occasionally in the 'tween deck spaces the stevedore seldom has a solid, even working floor, which would allow lifting appliances to be used. Proper overhead lifting facilities are practically non-existent. Packages contrived with an eye on machine working have for the most part to be dragged or prised into or out of position by main force, often in confined space, with inadequate headroom. Complete loading or discharge at a terminal port, *ab initio*, does at least allow cargo to be attacked at the most convenient point, but stowing or unstowing a block of cargo at a through port, breaking bulk it may be, or topping off, may entail shifting other cargo to gain access and subsequently restowing it. Much of this difficulty is brought about by the lack of suitable under-deck working gear, an aspect of ship design which so far, apparently, has received scant attention.

The future of the ocean transport of goods undoubtedly lies in the unitization of cargo in large uniformly-sized blocks—container working, in fact—not only difficult to "lose" but combining among their other virtues a readier capacity for preserving consignments in bill of lading lots. Nor does this necessarily entail a two-way traffic in merchandise *of the same kind*. A "package deal" of this sort raises administrative difficulties which we have previously touched upon; more particularly, of course, it will make larger, or at least different, demands on ship and shore facilities, involving a somewhat radical re-design of vessels with elaborate under-deck working gear, so that it must be looked upon very much as a long-term ideal, but certainly no fantasy. In the meantime, with cargo patterns as they now exist, useful improvements might well be achieved by providing in existing vessels a more rudimentary kind of under-deck hoisting equipment to facilitate the building up and distribution of unit loads of cargo in the square of the hatch. There are of course immense difficulties in designing compact and easily operated gear of this kind for shipboard use where an immediate objection is that it tends to become least usable when it is most needed. But there are several lines of attack. Once a need is recognised, a solution can usually be found and here perhaps is another field where the ingenuity of the materials handling industry might be put to work.

Deep Water Harbour at Barbados

Provision of Bulk Handling Facilities

(Specially Contributed)

IN past years the sea borne trade of Barbados has been centred on Bridgetown, the capital city of the Island, and has been handled at the Careenage which can only accommodate small coasting vessels and lighters. The Careenage is some 1,800-ft. in length with a mean width of about 250-ft. and a depth at low water ordinary spring tides of from 14 to 20-ft. in the middle and 9 to 12-ft. alongside the wharves.

The Careenage is used by lighters transporting cargo between freighters anchored in Carlisle Bay and the warehouses and storage sheds surrounding the harbour, which become very congested particularly during the season of the year when the sugar crop is being exported.

When Sir John Coode was asked to submit a report to the Barbados Government in 1883 on the feasibility of providing a deep water harbour at Bridgetown, he stated that " by no process of deepening or development can the Careenage be adapted for the reception of ocean going steamers and other large vessels which now frequent the Bay." These remarks are truer today than they were at that date on account of the greater size and deeper draught of modern vessels.

The Island of Barbados may be said to have two main sources of income, namely sugar and tourists. Depending upon the weather during the growing season Barbados produces between 120,000 and 200,000 tons of sugar per year and has an export quota, under the Sugar Agreement, of 150,000 tons per year. Under the present arrangements the sugar is bagged at the various factories and stored in warehouses in and around Bridgetown. On the arrival of a sugar export vessel the bags are loaded into lighters and transported to the ocean going vessel moored in Carlisle Bay. The sugar may be tipped out of the bags into the holds of the vessel or may remain in the bags, but in either case it may take up to 10 days to load 10,000 tons of sugar. If Barbados is to continue exporting sugar at an economical price then the cost of handling sugar into export vessels must be reduced and this can best be achieved by handling sugar in bulk by means of mechanical conveyor equipment.

Tourists' vessels, of which many call at Barbados, stay for about 24 hours and have to drop anchor in Carlisle Bay. The passengers who wish to spend the day ashore, have to be conveyed to the Careenage by motor launch which, on account of the swell, is often a deterrent and the tourists may decide it is better to wait until they are moored alongside a wharf, say in Trinidad, before having a day ashore.

It can thus be seen that to reduce the cost of handling sugar and to attract a greater number of tourists ashore there is every advantage in having deep water wharves in Barbados. Carlisle Bay can be considered a sheltered area from November to July but during the rest of the year the weather is unsettled and the months from August to October are known locally as the " Hurricane months." During high winds there is a moderate swell running to the north or north east across the roadstead. Even during the period of the north east trade wind there is on occasion sufficient " heave " in Carlisle Bay to render the transhipment of goods difficult. Thus whatever scheme of deep water berthage is provided, protection by means of breakwaters, is needed.

It is believed that the earliest report on improved harbour facilities at Bridgetown was submitted in 1873.

Reference has already been made to the report prepared by Sir John Coode in 1883, when he recommended the construction of an enclosed harbour in the north-east area of Carlisle Bay. In 1912 Messrs. Coode, Son and Matthews (successors to Sir John Coode) submitted a report dealing with the establishment of a

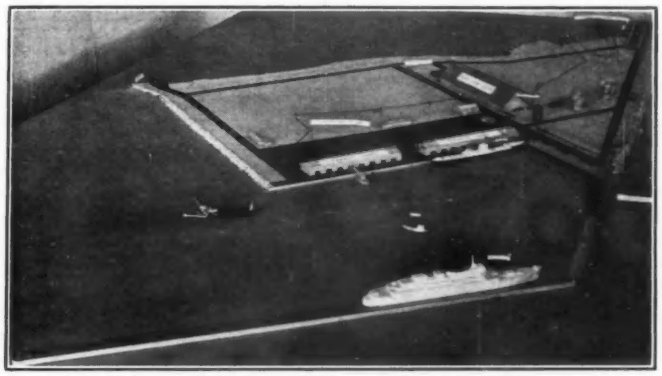


Fig. 1. Model of the new deep water harbour.

coaling dock at Needham Point in Carlisle Bay and making recommendations for deep water wharfage on the lines advocated by Sir John Coode.

In 1948, Messrs. Coode, Vaughan-Lee, Frank and Gwyther submitted a further report on the provision of deep water berths at Barbados when they again considered the site for a deep water harbour in the north-east of Carlisle Bay, as proposed by Sir John Coode, but they also put forward a proposal for a harbour to the north of the Careenage, referred to as the " North " scheme. This latter scheme was found to be less costly than the site proposed by Sir John Coode, and in addition was more compact, provided a considerable area of valuable land for development, did not add to the congestion in the area of Bridgetown adjacent to the Careenage, did not entail the acquisition of existing valuable properties and provided room for additional berths at a later date if required. In addition the construction of the harbour to the north of the Careenage would leave the open roadstead in Carlisle Bay available for the anchorage of large vessels.

Following the report of 1948 the Government of Barbados investigated the economics of a deep water harbour and in November 1955 instructed their consulting engineers, Messrs. Coode and Partners, successors to the various firms mentioned above, to prepare the necessary design drawings and to invite tenders. The Crown Agents for Overseas Governments and

Administrations, acting on behalf of the Government of Barbados, invited tenders on an international basis in October, 1956, and in August 1957, a contract was awarded to Messrs. Richard Costain (West Indies) Ltd., their tender amounting to approximately £3,680,000.

New Construction Works

A photograph of a model of the deep water harbour is shown in Fig. 1 and the main works comprise the construction of a protective breakwater, quay wall, inner berth, transit sheds, reclamation and a bulk sugar installation.

The breakwater consists of an inner arm, 1,006-ft. in length and an outer arm, 1,712-ft. long. It is built of solid concrete blocks, of an average weight of 15 tons each, set in sloping bond on a rubble base. The blockwork at the abutment of the inner arm, at the knuckle between the two arms and at the roundhead at the north end of the outer arm are set in horizontal bond. The rubble base, which is 10-ft. thick and 48-ft. wide at the top, extends to at least 5-ft. below the original sea bed. The breakwater, which is approximately 48½-ft. high, has a base width of 38-ft. and a top width of 37-ft. The concrete blockwork extends to a level of 3-ft. 4-in. above low-water level and is surmounted by concrete-in-mass, 6-ft. 8-in. thick. Along the outer edge of the breakwater superstructure an elevated promenade, 3-ft. wide and 4-ft. 6-in. high is provided together with a parapet wall, 4-ft. wide and 8-ft. high. The effective width of roadway on the breakwater is 30-ft. and the roundhead at the outer end provides a turning circle of some 39-ft. radius. The breakwater extends to the 6 fathoms contour and, with the quay wall opposite, will form a sheltered area of water of about 40 acres.

The quay wall, which is also built of concrete blocks of the same size as in the breakwater and likewise set in sloping bond, is 1,211-ft. 9-in. long, thus providing two berths each of 600-ft. in length. The blocks are laid on a rubble base having a minimum thickness of 5-ft. and a top width of 28-ft. 6-in. The underside of the quay wall is at a level of 33-ft. 9-in. below low water level and the blockwork extends to a level of 3-ft. 4-in. above low water level. The blockwork is surmounted by a concrete-in-mass superstructure extending to 10-ft. above L.W.O.S.T. Although no wharfside cranes are being provided at the present stage provision has been made for crane rails to be laid at a later date. The outer crane rail will be carried on the concrete superstructure and the inner rail on a reinforced concrete beam spanning between precast concrete piers, 3-ft. square, at 19-ft. 6-in. centres, founded on a step at the rear of the quay wall.

The two arms of the breakwater and the quay wall are provided with cast steel cope bollards at 73-ft. centres and have a horizontal greenheart fender consisting of a 10½-in. by 14-in. backing piece fixed to the concrete superstructure by mild steel straps, and a 7½-in. by 14-in. greenheart rubbing strip fixed to the backing piece by coachscrews. Mild steel vertical ladders are recessed in the face of the quay wall and breakwater at 219-ft. centres and boatsteps are provided, one at the end of the quay wall, and three along the breakwater, one at each end and one at the knuckle.

Freshwater hydrants, fed from a cast iron spigot and socket main, are installed at 219-ft. centres along the quay wall and the breakwater and oil valve chambers, for bunkering vessels are provided at similar centres.

A service tunnel, 3-ft. 6-in. wide by 5-ft. 6-in. high, is constructed within the superstructure of the breakwater, which will accommodate the water and fuel oil mains, electric cables and, for the inner arm of the breakwater, pipes for the export of molasses. Telephone plug boxes, for ship to shore connection, are also provided along the quay wall and breakwater.

The Inner Berth, between the quay wall and the inner arm of the breakwater, is 500-ft. long and is for the berthing of coastal steamers and schooners. The berth was designed to be of reinforced concrete piles supporting a reinforced concrete deck but the first test pile driven into the coral sea bed did not produce the required set at 60-ft. penetration. The berth was redesigned using three rows of precast concrete hexagonal piers at 25-ft. centres longitudinally, carrying reinforced concrete beams supporting the deck slab. It was necessary to design the Inner Berth as an open structure beneath which is provided a wave slope for the dissipation of any swell entering the harbour from the north. Openings are provided along the rear of the deck slab for the release of air trapped by any northerly swell.

The contract required that the harbour should be dredged to a depth of 32-ft. below L.W.O.S.T. but the contractors were

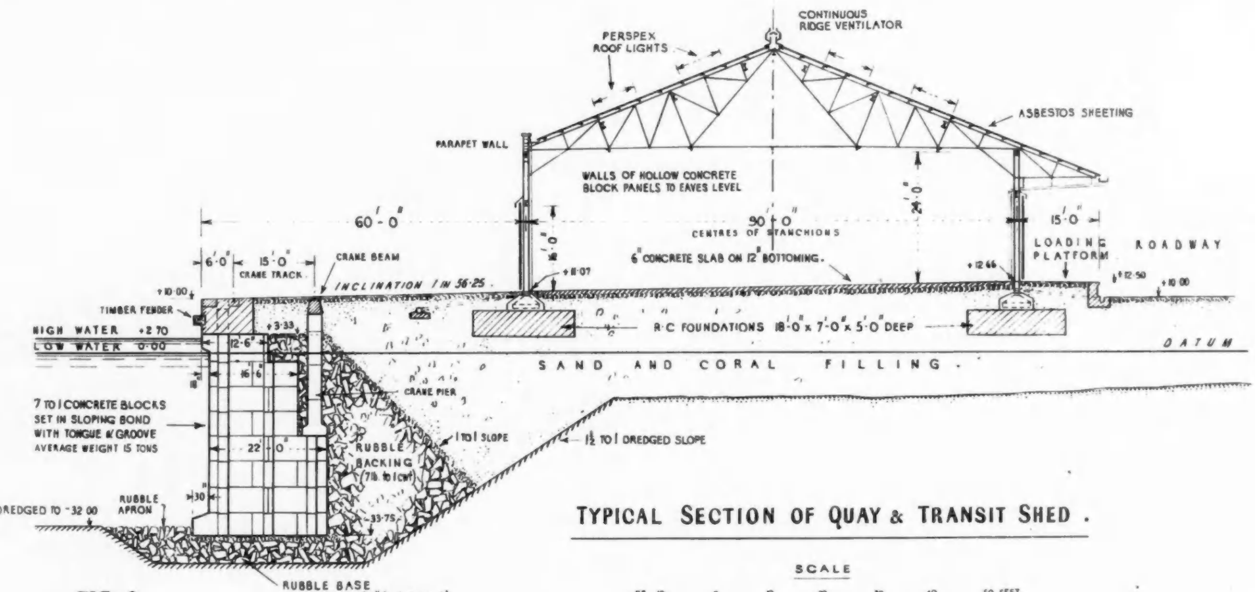


FIG. 2.

allowed to dredge to a greater depth in the middle of the harbour in order to obtain the additional material required for the reclamation area. The sea bed consisted of finger type coral with some sand and the contractors used a cutter suction dredger with spud legs, these legs being alternatively raised or lowered thus permitting the dredger to be "walked" over the sea bed. The dredger in addition pumped the dredged material straight into the reclamation area at a rate between 300 and 550 cubic

Fig. 3. Panoramic view from roof of Sugar Store, showing Stacking Area and Transit Sheds.

yards per hour, dependent on the type of material, through a 24-in. diameter pipeline up to 2,000-ft. long. A total of some 1,700,000 cubic yards of material has been dredged and pumped ashore to provide a reclamation area of some 87½ acres at least half of which will be outside the customs area and be available for industrial development.

The north and south sides of the reclamation area are retained by rubble banks having a top width of 10-ft. The banks have a rear slope of 1 to 1, whilst the north bank has an outer slope of 1½ to 1 and the south bank, which is exposed to the prevailing swell, has an outer slope of 2 to 1. Both banks are formed of rubble, no individual stone weighing less than ¼ cwt. and they are faced on the outside with stones not less than 2 tons in weight.

Transit Sheds and Storage Facilities

Each of the two berths at the quay wall are provided with transit sheds, one 425-ft. and the other 475-ft. long and both 90-ft. clear span. These sheds are of steel columns and roof trusses at 25-ft. centres, the underside of the trusses being at 24-ft. above floor level. The walls of the shed are of hollow concrete blocks, 9-in. thick, and the roof is sheeted with corrugated asbestos cement tiles and staggered "Unilux" laylights. Sliding doors, giving a clear opening 23-ft. 6-in. wide by 16-ft. high, are provided in every other bay on the harbour and the landward side of each shed. The floors of the sheds are of hardcore bottoming, 12-in. thick, a concrete slab, 4½-in. thick and finished with hardened granolithic concrete, 1¼-in. thick. A loading platform, 15-ft. wide, and protected by a canopy of the same width, is provided along the rear of the sheds to facilitate the loading of imports into lorries and the locally used donkey carts. A small examination cage is provided in one corner of each shed over which has been built an office for the Customs Department and the cargo handling organisation. The quay apron, which is of two course asphalt macadam on a foundation of hardcore bottoming, 9-in. thick, rises at a slope of 1 in 56¼ from the cope line and then through the shed to provide the loading platform at the rear. A cross-section of the quay wall and transit shed is shown in Fig. 2.

Since the contract was let the Government has decided that a third transit shed shall be provided to serve the Inner Berth. This shed will be 350-ft. long by 60-ft. wide and is to be a standard Coseley building, with sliding doors in alternate bays, but there will be no loading platform at the rear.

In the rear of the two quay wall transit sheds a stacking area, 1,200-ft. long by 200-ft. wide, is being constructed for the storage of import cargo that does not require to pass through the transit sheds. A road, 65-ft. wide, is being constructed between the transit sheds and the stacking area, and a road, 40-ft. wide, is to be provided to the landward of the stacking area. To the landward of this latter road an area, 1,200-ft. long by 295-ft. wide, is reserved for the future construction of warehouses. Access to the transit sheds, stacking area, etc., is provided by two roads, each 40-ft. wide running in an east-west direction. All roads and surfaced areas are of two course asphalt macadam of a total thickness of 5-in. on a foundation of hardcore bottoming, 9-in. thick. Open drains are provided alongside all roads and surfaced areas and these drains, together with pipe drains from the rainwater pipes on the various buildings, lead to four main outfall drains, 12 to 24-in. diameter, which discharge into the harbour through the quay wall. A fence, 8-ft. high, of chain link fabric on reinforced concrete fence posts, surrounds the whole of the Customs area.

A general view of the transit sheds and stacking area is shown in Fig. 3, whilst Fig. 4, shows the quay wall and transit sheds in the background and the Inner Berth under construction in the foreground. An internal view of one of the transit sheds under construction is shown in Fig. 5.

Before the construction of the harbour commenced the drainage of the Fontabelle area, immediately north of Bridgetown, discharged into the sea. The inverts of these drains were only just above L.W.O.S.T., and thus when the area between the foreshore and the quay wall was reclaimed it became necessary to make

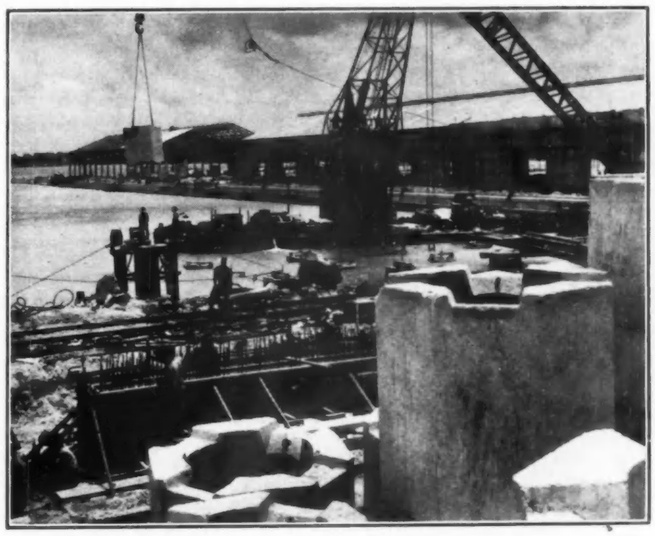


Fig. 4. Inner Berth and Transit Sheds under construction.

special provision for the drainage of the Fontabelle area. This has been done by the construction of a large open drain, into which the existing drains discharge, at one end of which is a sump provided with No-flote controlled pumps, which discharge the water through the south rubble bank into the open sea. Sluice gates have been provided so that at certain states of the tide and the level of the water in the drain, the water will discharge by gravity and the pumps will not be operated.

Bulk Sugar Handling Plant

As mentioned earlier one of the advantages to be gained from any deep water berths in Barbados is that it will enable export sugar ships to lie alongside a wharf in calm water and be loaded with sugar in bulk. It has thus been necessary to provide within the harbour area a bulk sugar installation. To the south-east of the quay wall, as will be seen in Fig. 1, a sugar store will be provided. This store will be 562-ft. 6-in. long and have a width at floor level of 150-ft., with a height from floor to apex of 101-ft. Allowing for the natural angle of repose of the sugar, approxi-

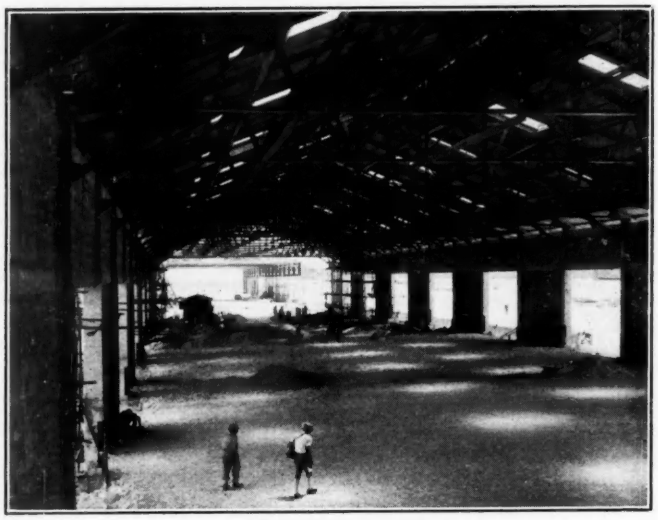


Fig. 5. Interior of Transit Shed No. 2.

mately 38°, above the level of the side retaining walls, it will be possible to store up to 80,000 tons of sugar in bulk in the store.

The sugar will be transported from the various sugar factories to the harbour in specially made metal containers, of 5 tons capacity, fixed to ordinary flat lorries. On arrival at the Reception House at the eastern end of store, the lorries will stop on a 15-ton weighbridge platform, when the lorry, its container and the sugar will be weighed. The container will then be tipped by means of an electric hoist hooked to one side of the container and the sugar will be discharged into a hopper through a top hung door on the side of the container. When the sugar has been discharged the container will be lowered on to the lorry and the lorry and empty container will again be weighed before the lorry returns to the sugar factory. Two weighbridge platforms, one on each side of the hopper, will be provided as it is anticipated that during the peak period one lorry will be arriving at the reception centre every 2½ minutes for possibly 24 hours each day.

From the hopper the sugar passes on to conveyor belt No. 1 which is 820-ft. long and 42-in. wide, and the belt passes from the hopper in the tunnel under the sugar store rising above ground at the western gable end where it continues in a steel gantry to the weigher tower. There the sugar passes through the first hopper and if going to the store the sugar feeds on a conveyor belt No. 2, which is 640-ft. long and 30-in. wide. This belt is in a steel gantry rising from the weigher tower to the roof of the store and continues along the apex of the store for some 450-ft. The sugar is automatically discharged from this belt into the store by means of a travelling tripper which passes the sugar into a travelling thrower. This thrower has a short length of belt conveyor running at a speed of 2,400-ft. per minute and can throw the sugar in a fine spray horizontally for a distance of approximately 50-ft.

In the floor of the store, and over the tunnel housing conveyor No. 1, louvred hoppers, having an opening 4-ft. square, are provided along the full length with 4-ft. clear between each opening. Each hopper is provided with three sets of special adjustable louvres, hand operated, for controlling the rate of discharge of the sugar on to one of the three travelling feed hoppers, running on rails, which in turn feed on to conveyor No. 1. Thus when sugar is to be loaded into an export vessel the sugar is drawn out of the store on to conveyor No. 1, which again conveys it to the weigher tower. After passing through the first hopper, as before, the sugar is discharged into a second hopper of 20 tons capacity where it is weighed by means of a fully automatic Servo-Duplex weigher, having a capacity of 500 tons per hour and will weigh to an accuracy of 0.1 per cent. In addition to indicating the weight of each individual weighing, the total weight passed through will be recorded.

After passing through the weigher hopper the sugar discharges into a third hopper and then through an outlet and regulating gate on to conveyor No. 3. This conveyor is 540-ft. long and 42-in. wide and is housed in a tunnel which passes behind the Inner Berth to the Transfer House at the root of the breakwater. At this point the system turns through an angle of 135° and the sugar is fed on to conveyor No. 4, which rises out of the ground and is housed in a steel gantry. Conveyor No. 4 is 480-ft. long and 42-in. wide and terminates at the first ship loader, A, sited 266-ft. along the breakwater. Ship loader, B, is a further 80-ft. along the breakwater and ship loader, C, a further 180-ft. beyond B. A 42-in. wide conveyor belt in a gantry is provided between loaders A and B and B and C.

The ship loaders are fixed and consist of braced steel structures having the lower portion designed as a portal to provide access along the breakwater. The loaders are provided with booms carrying conveyor belts, 60-ft. long and 42-in. wide. At the outer end of the booms telescopic delivery chutes are fitted and at the lower end of the chutes high-speed throwers, as on the tripper in the roof of the store, are provided so that the sugar can be

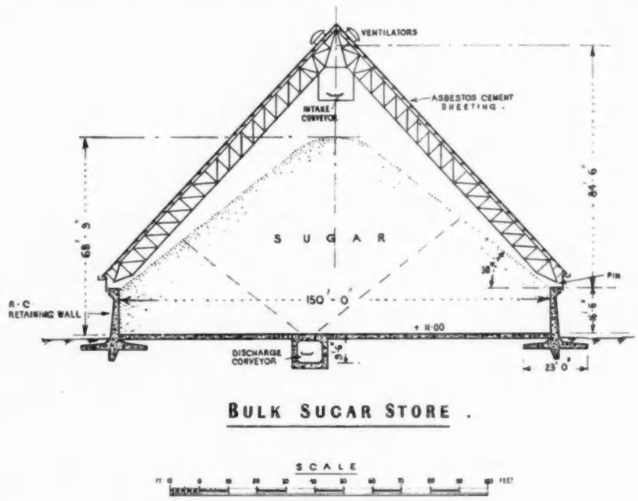


FIG. 6.

"thrown" into the far corners of the ships' holds. The booms are capable of being swung through an arc of 80° and with this movement for each boom, and the spacing of the three loaders it anticipated that sugar can be discharged into any hold of any likely export vessel without having to warp the ship along the berth. The throwers, at the lower end of the chutes, can revolve through 360° and it is thus possible to fill the holds of the export vessel completely without hand trimming. Should it be necessary the sugar can be discharged straight from the bottom of the chute and by-pass the throwers.

Part of the sugar on conveyor No. 4 can be ploughed off to feed ship loader A and a further portion can be ploughed off conveyor No. 5 to feed ship loader B, the balance proceeding to ship loader C. Alternatively sugar can be fed to only two or only one of the ship loaders. The loaders will be able to load 10,000 tons of sugar into a vessel in about 24 hours as opposed to the 10 days it takes at present from lighters. The sugar installation can work night and day and can be operated by as few as 6 or 7 men when loading to ship only and by 3 or 4 men when receiving from factory and placing into store only.

All 42-in. wide belts will run at a speed of about 350-ft. per minute and these belts will have a capacity of 500 tons per hour. Conveyor No. 2, in the roof of the store will have a capacity of 150 tons per hour and will run at a speed of about 250-ft. per minute. Conveyor No. 1 will have a two-speed motor so that when sugar is being received from the factories and taken to store it will have a capacity of 150 tons per hour but when loading to ship it will have a capacity of 500 tons per hour. Should sugar be delivered from the factories, whilst an export vessel is being loaded, then the sugar will pass direct to the ship and will not go through the store. As the sugar will not be received from the factories at the loading rate of 500 tons per hour sugar will be drawn from the store and added to that from the factories on conveyor No. 1, profile plates being provided to ensure that this conveyor is not overloaded.

Sugars produced in the various islands of the West Indies all have different characteristics and moisture content and it is not known exactly as to how freely Barbados sugar will flow when stored in bulk to a height of some 68-ft. By the use of conveyors Nos. 1 and 2 it will be possible to "circulate" the sugar through the floor hoppers and in again from the roof and it is considered that if the sugar can be "circulated" after arrival at the store there will be less likelihood of it sticking and forming a solid mound. An excavator has been purchased in case it should be necessary to "excavate" a high vertical face of sugar

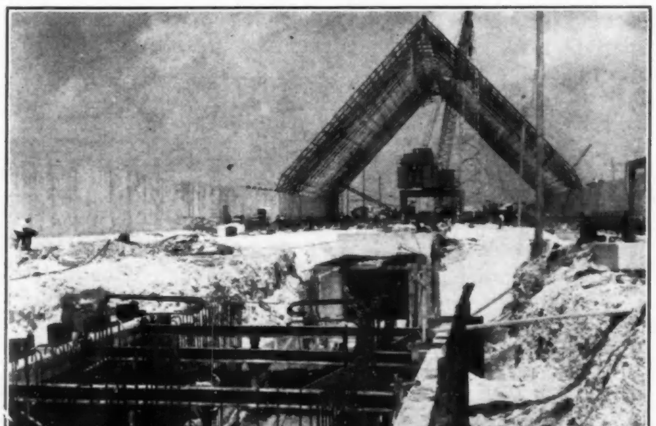


Fig. 7. Subway No. 1 and Sugar Store under construction.

when drawing out through the floor and small mechanical shovels are also being purchased to move the sugar from the sides of the store to the central hoppers.

The whole of the sugar installation is electrically operated and interconnected so that if one conveyor should break down then all conveyors feeding that one will be automatically stopped. The conveyor belts are of rubber and canvas with 32 oz. duck and have a top cover of 1/8-in. thick and a back cover of 1/16-in. thick in grade "B" rubber. The 30-in. wide belts are 5-ply thick and the 42-in. belts 6-ply thick. Scraper and rotary brush gear is provided on the discharge end of all belts for cleaning off sugar and an atomised spray of water, which only operates when the belts are in motion, is fed on at the head of the belts to prevent sugar adhering thereto. Each belt, which is endless and has a vulcanised joint, is provided with tensioning gear, which in the case of the short belts consists of a screw type tightener and for

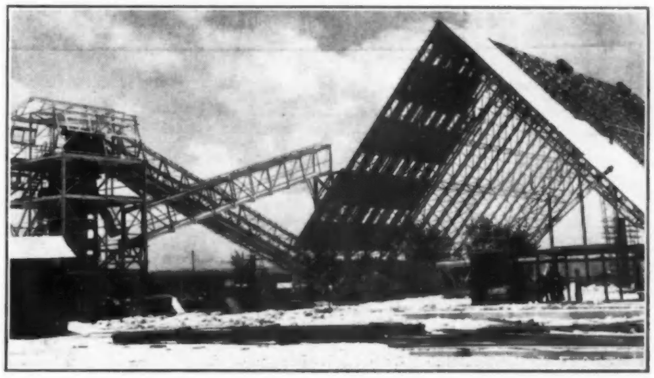


Fig. 8. Sugar Store and Batch Weigher Tower under construction.

the long belts the tensioning gear is of the automatic drop weight type.

A cross-section of the sugar store is shown in Fig. 6. The side walls, which are of reinforced concrete, are 17-ft. 6-in. high, and in addition to acting as retaining walls for the sugar, they carry the roof trusses which are pin jointed. The trusses, which are at 12-ft. 6-in. centres, are 5-ft. deep and were riveted and bolted together at the site. The roof of the store is sheeted with corrugated asbestos cement tiles and staggered corrugated "Unilux" laylights. Along the apex, staggered on each side, are 12 electrically-operated extractor fans with louvre blades which close when the fans are not in operation. The floor of the store consists of a blinding layer of concrete, 2-in. thick, on which is laid a waterproofing medium, and then a concrete slab, 8-in. thick, reinforced on both faces with fabric reinforcement. The upper surface of the floor is painted with three coats of Flintkote type 3 emulsion followed by a protective screed of Flintkote emulsion mixed with sand and cement of a total thickness of ½-in.

The tunnel under the store for conveyor No. 1 and the tunnel from the weigher tower to the transfer house for conveyor No. 3 are of reinforced concrete, and the bottom, sides and top of both tunnels are covered externally with a waterproofing medium to prevent any possibility of ground water finding its way into the tunnels. The waterproofing medium around the tunnels and under the floor of the store consists of two layers of Pluvex No. 1 bitumen dampcourse bonded between three layers of Ruberoid compound.

Part of the sugar store and the tunnel under the floor, whilst under construction, is shown in Fig. 7 and Fig. 8 shows the weigher tower, the gantries partly constructed for conveyors Nos. 1 and 2, and the store with the roof sheeting being laid. The mechanical conveyor equipment has been manufactured and is being installed by Messrs. Spencer (Melksham) Ltd., as subcontractors to Messrs. Richard Costain (West Indies) Ltd.

The contract date for the completion of the works is 20th August, 1961, but, despite the addition of certain extra works, Messrs. Costain have made such good progress that it is anticipated that the works will in fact be completed by the end of March 1961. It is hoped to test the bulk sugar installation early in July, 1961, and to load the first sugar ship during February.

The Handling and Transport of Package Goods

Factors which Influence Cargo Working

ONE of the papers read at an International Cargo Handling week organised by I.C.H.C.A. in Antwerp in June last, presented the cargo handlers' point of view on packaging. In opening his talk, the author, Mr. J. Sirtaine, mentioned that the term cargo-handler often needed amplification. In Antwerp, for example, there was a rather special situation. Two kinds of cargo handlers exist there; the native Flemish port authorities and the stevedores. Although the functions of the stevedores were widely known the same could not be said of the port authority, and it was worthwhile therefore to study the difference between the two:—

> The port authority carried out the discharge and loading of railway trucks, lorries and sometimes lighters. It dealt with the reception of goods on discharge from ships and with the placing of them in warehouses or depots. Finally, it carried out transportation within the port area and also to medium and long distances.
>
> The stevedore undertook the loading and discharge of ships and lighters.

Briefly the field of activities of the first covered roughly all the cargo handling carried out on land and the second, that carried out on water.

Mr. Sirtaine went on to say that this essential difference in their activities directly affected their points of view as regards packaging. Their problems were completely different. The port authorities' activities took place in open spaces or in warehouses, the floor surface and expanse and height of which generally permitted the use of mechanical equipment. The intervention of the manual labourer was thus relatively small. Forklift trucks, conveyor belts, cranes, trans-shipment cranes, stackers, tackle, conveyors and roller carriers enabled cargo handling to be carried out almost entirely mechanically. So for the corporation, packaging should be carried out with a view to mechanical handling.

The stevedore, on the other hand, worked in a confined space —the ship's hold. The floor, or "ceiling", was hardly ever seen, owing to the presence of goods which had been loaded at other ports or had remained on board, and the height and space were limited. In the traditional construction of ships, the large deck plates, tweendecks, hatchways, manholes, strakes and deep tanks made the use of machines almost impossible. There were, too, the difficulties of the lack of space and the construction and those of the work itself. "For example," he said, "in the course of loading, a cargo destined for the first port of discharge is available before that destined for the second port. This prevents systematic stacking. It is therefore necessary to make room in an already limited space, rendering the manœuvring of a machine out of the question. And yet, the packages have to be placed under the deck plates, which vary in width from 2 to 7 metres. Merely placing them by cranes or winches under the square of the hatch is not sufficient. The reverse applies on discharge, and there is obviously only one solution—manual handling. So, for the stevedore, packaging should be carried out with a view to handling by hand."

Having made these points, the speaker turned to packaging. For his purposes, he explained, it would be fair to define "to package" as follows: to put goods into packing cases, bales, or cardboard boxes, with a view to preventing their dispersal and/or to protecting them against possible blows. "These last words," he said, "will not meet the approval of everyone. Many manufacturers consider that packaging consists merely, even for valuable or fragile goods, of a simple container. It must be admitted that this way of looking at things is rather over-simplified, particularly since these same persons are the first to complain when damage has been done.

This is no exaggeration. Instances are known where finished products, valued at 15 to 20,000 Belgian francs and extremely cumbersome and fragile have been despatched in cardboard boxes. In such circumstances the attitude adopted by the cargo handler should be as over-simplified as that of the manufacturer: that the latter absolve him of all responsibility, for with the best will in the world he cannot avoid damage. Nevertheless, most manufacturers will accept the principle:

packaging=protection for fragile and valuable articles.

Having established the definition, Mr. Sirtaine continued, "let us consider the point of view of the cargo handler. Here my preliminary remarks assume their full importance. The point of view of the port authority is in fact characterised by the use of machines. The shape and size of the packages are of little consequence, for the range of mechanical equipment on the market is so vast that no matter what problem of handling is posed, it can be easily solved. But one remark should be made: the packaging must be strong.

As regards the stevedores, I have said that the handling on board ship is done almost entirely by hand. If the shape of the packages does not matter, their size and the weight of the contents are on the contrary, of the utmost importance. Even when many men unite their efforts, physical force has a limit. To be sure, the men make use of equipment, but this is extremely primitive—hooks, crowbars and skids. For manœuvring packages under the deck plates, they are obliged to resort to the antiquated system of traction by means of pulleys and gantlines. Therefore the packaging must be extremely solid.

In the case of smaller packages, all too often hand-holds are omitted—for example, on bales of jute cloth or fibres, most of which are flattened and hooped. They weigh from 200 to 800 Kgs. No holds, such as ears at the corners, are left. The workers have nothing to grip and the 'use no hooks' injunction forbids their use. How can these bales be stacked in the hold? How can they be lifted, remembering that there is no lifting gear available? I prefer not to attempt an answer, but merely to remark that a fair number of physical and material accidents are due to defective packaging proceeding from a lack of knowledge on the part of the factories and packers of the problems of cargo handling on board ships.

Having sketched this outline, I propose to examine types of packaging relating to cargo and cargo handling. The diversity of products transported is very wide, and it is therefore necessary to limit examination to the most representative examples. These have been classified according to the different types of packaging, describing in turn bindings, paper sacks, jute sacks, drums, crates, cardboard boxes and packing cases.

1. Bindings

The simple binding offers no protection whatever and serves merely to prevent dispersal of the goods. It ranges from a wire to a hoop. In most cases they are too loose and badly tied, particularly the wire ones. For example:—

iron and steel bars: these are exported in bundles varying

from 1 to 3 tons and from 6 to 12 metres in length. All too often the bindings slide the length of the bars as soon as the bundles are lifted.

bales of paper: these are not rigid and in the course of being handled inevitably have a certain amount of play. It is then sufficient for one or two sheets to slide out for the entire bale to loose its shape.

The result: extremely difficult handling, unstable stowing and quite a bit of extra expense in connection with the cleaning up of the quay after the removal or loading of these goods.

bales of cardboard: lend themselves very well to this form of packaging, the more so because the edges are protected by means of wooden braces. The only inconvenience is the lack of protection against rain.

bales of wood pulp: also lend themselves very well to packaging by binding.

" Unalit " bundles: although protected on the sides by means of boards, these bundles disintegrate immediately. That is, the length of the plates, their lack of rigidity and the impossibility of tying the bindings tightly allows twisting when the bundles are lifted. The twisting is such that the bindings loose all effect and the plates start to slide in every direction.

2. Sacks

Paper or jute sacks are generally used as packaging for goods which are not valuable or fragile. The costs of possible losses from the contents due to leakage from tears are small. They are mere containers, offering no protection other than against dirt.

cement: cement is packed in 6-ply paper sacks. This packaging is excellent. It is fairly proof against rain and very strong. One remark: if the sack is filled when the cement is too warm, the paper hardens and tears easily.

fish meal: this is packed in 3-ply paper sacks. These are less resistant than sacks for cement. Often they are filled too full, which renders them more vulnerable and hinders the workers from getting hold of them easily.

carbon black: this is packed in paper sacks. Here is a product which should not be allowed to be transported in this manner. It is in fact so powdery, that there is always leakage, yet during handling a small amount of tearing is inevitable. The troublesome consequences are incalculable. A cloud of black dust immediately covers everything around, contaminating other goods in the vicinity and obliging the carriers to clean the hold and/or quay repeatedly. The men themselves have the right to high rates of extra pay for handling this product.

chalk, lithopone, talc powder: these products adapt themselves very well to paper sacks. One inconvenience: when torn, other goods may be contaminated.

flour, grain and seed, rice, beans, soda, phosphate, coffee, sugar, oilcakes: all these products are packed in jute sacks. There is one remark to make. Whereas, in the days when the sacks were hand sewn, " ears " were left which afforded the workers a hold, it is now no longer so, since the sacks are mechanically sewn. As they slip easily out of one's hands, the workers, in spite of continually being forbidden to do so, have a tendency to use hooks, thus making small holes and sometimes tears.

3. Crates

Crates cannot be considered as an effective packaging from the point of view of protection. In general, goods packaged in this way suffer considerably. For example:—

machinery: it sometimes happens that factories despatch heavy machinery packed in crates. These are strong enough for transportation by railway truck, but in a ship, where they have to be stowed on top of each other under the deck plates, they do not stand up to handling nor to transportation.

4. Cardboard Boxes

These are used for consignments of uniform goods. As each has identical dimensions, they enable stowage to be compact and solid. For example:—

preserved fruit, tinned milk, empty bottles: inconveniences include:

(a) they are easily cut and opened, the cardboard giving no protection against theft;

(b) when damp, they lose their rigidity and collapse. This last point concerns the carrier in particular; from the point of view of the dock worker, the packaging is excellent because of its uniformity.

5. Drums

This type of packaging is excellent. Not only does it afford first rate protection to the goods, but also enables it to be very speedily handled. For calcium chloride, for example, a rate of up to 70 tons per hour per gang is reached when loading a ship.

However, two conditions are necessary:

(a) the sides must protrude beyond the lids so that the special hooks used by the dockers can get a grip;

(b) the drums must be manœuvrable in a horizontal position. This is not always the case—for example, in consignments of butter and vegetable fat where the drums are fitted with a lid held on by means of a special hoop. At the least shock this hoop opens. Handling has therefore to be carried out by means of a platform on which the drums are placed upright. This means of handling is naturally much slower and consequently more expensive.

6. Barrels or Casks

This type of packaging is tending to disappear and it is difficult to make an authoritative review. The only goods still handled at Antwerp in a packaging of this type are tobacco and wine.

7. Packing Cases

The great advantage of the packing case is its solidity. Goods packed in this way are so varied that it is impossible to go into details here. Everything from eggs to heavy machinery, from fruit, crockery, preserves, plate glass, textiles, to plants, can be despatched in this form of packaging. Unfortunately, however, all too often dead wood is used for the manufacture of packing cases. At the least shock the planks split, causing damage to the contents.

As regards plate glass, the wood used for making the case is often damp. This gives rise to unending disputes on the subject of restrictive remarks inserted in the Bills of Lading. The ship, claiming that the cases have been exposed to bad weather before arriving on the quay, demands a clause covering it against all damage by damp. The consignor, claiming that the wood was damp when the case was made, refuses to sign this clause. Discussions, loss of time, examinations and useless expense are the result. Yet both are right, if one considers that the cases could have been exposed to bad weather in the course of transportation.

There now only remain goods despatched in bulk. I admit that it is surprising to speak here of unpacked goods, but it is precisely this lack of packaging which incites me to do so. I shall not linger over minerals, coal, sand, building materials, wood etc., which it is normal to transport without packaging but deal rather, with goods such as motor cars, ingots, tyres, marble, tiles and machinery, which are frequently despatched unpacked.

When considering
(1) the fragility, particularly of motor cars, marble, tiles and machinery;
(2) the possibilities of theft, for ingots, tyres, tiles and certain motor car accessories; and
(3) the slowness of handling tyres, tiles and marble;
we come to the conclusion that packaging is certainly desirable, if not essential.

The whole range of packagings has thus been reviewed and the various qualities and faults noted. This glimpse is necessarily very limited. I hope that the producers and packers will nevertheless obtain some information from it."

Mr. Sirtaine concluded by stating that he was perfectly aware that packaging affects the producer's cost price and that the producer tried to limit expenses. It was not the speaker's business however, to give advice to all and sundry, but the point did arise as to whether the producer's policy was not rather short-sighted. The customer, who had a well established sales programme, hated to see his order arriving in a bad state, even if someone else had to foot the bill. Yet restrictive clauses, such as "packing too weak or insufficient," would affect cost prices even more in the case of damage than a solid packaging.

Be that as it may, it was above all the lack of knowledge of the problems of cargo handling which was the basis of defective or inadequate packaging. An engineer was recently heard to declare: "I manage to handle my goods at the factory without making a case. What happens elsewhere is not my affair."

That was the wrong way of looking at things. The advantages to all—producers, transporters, dock workers—were dependent on the satisfaction of the customer. It was therefore right that each should take an interest in the problems set by production, transport and handling. The dock workers' trade unions had technical commissions available for the regular study of handling problems. They would certainly be pleased to give their attention to the solving of problems set by packaging.

For his part, if the brief study that had been made had brought a litle grist to the mill, he would be very happy.

The problem discussed by Mr. Sirtaine is a very real one—but to solve it is not easy even for the packer. In effect, he is asked to pack his goods so that they are suitable for mechanical handling ashore and manual handling on the ship and he might well question why only part of the work at docks has been modernised. The long term solution is to be found, of course, partly in the field of ship design and an article has already appeared in this Journal on "Cargo Handling and Ship Design," in which the author, Mr. E. S. Tooth, emphasised that modern handling methods require modified ship construction.

The Packer's Point of View

A reply to this paper, giving the cargo handler's point of view, was given by a packer's representative, Mr. A. Rigal. After describing the efforts of a gang of men to pick up with a forklift truck a case without bearers which had been placed flat on the floor of a lorry, Mr. Rigal continued: "Large wooden packing cases are of the 'framed' type, i.e. they are constructed according to the following principles:—

The base of the case supports the whole load and is therefore particularly strong.

The sides and top are so constructed as to resist vertical compression and give the whole package rigidity.

The top (cover) is assembled to enable the case to be closed and other packages, which might be stacked in the course of storing or transportation, to be placed on it.

The base of the case is the strongest part. To it are fixed the handling skids. The handling of a load such as this has to be done by the base and the use of grapnels (case clamps)

This method of proceeding is a basis for determining the suitability of a package for stacking. Other factors, however, should be taken into account. Certain products contribute to the resistance of the case, for example, tins of preserves. On the other hand, even when similar cases are piled, they are not placed exactly one on top of the other and the corners and edges do not coincide. Remember that the resistance of a panel is noticeably weaker in the centre than at the edges.

The temperature and humidity of storing places should also should be forbidden. In fact, grapnels produce a lateral pressure on the case just where its resistance is weakest. To guard against this risk, the packer is obliged to reinforce the top part of the case, which increases the price of the packaging considerably.

We would point out also, that grapnels require the planks to support relatively heavy pressure, through a series of points being driven into the wood to a limited depth. The demands made on the fibres by wrenching can exceed their adherence to each other, so that the grapnels slip and the package falls as a result.

Asbestos cement sheets are often made up in loads consisting of two slatted frames bound to each other by metal rods. The frame beneath the load is fitted with skids which fix the position of the slings. Slings used without spreaders cause pinching of the upper part of the load and the consequent crushing of the plates.

These extreme examples are mentioned to underline the close relations which exist between packaging and handling. Without a doubt, the packaging must be adapted to its handling and transportation, but in addition, the economy effected by the mechanical handling which replaces manual handling should not be cancelled out by an increase in the price of packaging as a result of the strengthening. It should be remembered that, amongst the different conditions which packaging has to fulfil, those which afford protection to the goods and facilitate handling and storing are the principal. In any case, however, handling and transport have to adapt themselves to the needs of the producers and the users, for the essentials are production and sale, imperatives which always take precedence over others. But from the practical viewpoint, to assist handling and avoid destruction, the packaging should be easily handled.

To suit the many conditions of use, a satisfactory packaging will be a compromise between the maximum number of required conditions, and the lowest cost price. These conditions relate to:
(1) the protection of the goods themselves against shock, vibration, corrosion, etc.;
(2) storage conditions, weight, aptitude for stacking, durability;
(3) handling equipment, sling hooks, width of corridors for fork-lifts, correct placing of the slings, restricted loads, etc.;
(4) conditions of transport, temperature, dimensions, etc.

Great progress has indeed been made in this sphere, but not yet enough, since the damage rate still remains very high due to lack of proper interior make up and insufficient protection against shock, vibration, insects, climatic conditions and, as regards the last named, often apparent ignorance or underestimation of them.

It is to this end that all the energies of certain firms should be directed. Sometimes, however, the exporter, after taking extraordinary pains to protect the goods, places them well wrapped up and protected in a mediocre or badly designed case, which deteriorates during the voyage, thus wiping out at one stroke the energy and expense employed on the interior make up.

Storage Conditions

It is estimated that a package in a warehouse must withstand piling up to 4.50 m. in height. In ships, except in exceptional circumstances, the height is 2.60 m. and in railway trucks and lorries it is 2 m. It is assumed that the pile is made up of packages similar to the one in question and a safety coefficient of 30% is reckoned with.

be taken into consideration. These two factors vary considerably between one region and another and according to the method of storing—closed warehouses (air conditioned or not), or open sheds (giving protection against rain), or storing in the yard (the goods being possibly covered by a tarpaulin).

Finally, the length of storage should be taken into account, not only when determining the resistance of the packaging to compression, but also the type of protection which the packaging must afford its contents.

Handling equipment

There is no point in enlarging here on the conditions which a package has to fulfil for handling by mechanical means. These are now well known. Besides, they are generally taken into consideration by the companies who are interested as consignors and packers.

I should like, however, to remind you that the handling skids must be securely fixed by nails or flat headed screws.

But to continue Mr. Sirtaine's line of thought, in considering the whole of maritime handling operations, it may be concluded that those on the quay are generally well defined, but for the terminal part of those on board, the present practice of sliding the load requires skids of considerable strength. They should have a minimum section of 50 x 50 mm. The openings permitting the passage of truck forks should be at least 25 cm. long and separated by at least 65 cm. from axis to axis. They should be placed in such a way that a vertical line passing through the centre of gravity of the load should be between them. The openings for the slings should be at least 12.5 cm. wide; 25 cm. if possible. They should be placed at the edges of the base when the length of the package and the position of the openings for the truck forks permit it. It should be noted that these opening can also be used as positions for the slings when the package is not too long.

On the package should be indicated, besides the conventional markings, its centre of gravity, the positions for the slings, and, although this is in any case obligatory, the gross weight of the package. In addition, for packages whose dimensions and type do not permit the attachment of skids, the dimensions should be adjusted to standard or currently used pallets so as to constitute rational loading units. This means, adjustment to pallets with a surface size of 800 x 1,000 mm., 800 x 1,200 mm. 1,000 x 1,200 mm., 1,200 x 1,800 mm., and 1,500 x 1,500 mm.

As regards the goods despatched in bulk of which Mr. Sirtaine has already spoken, may I remind you of the 'palletised load' without a pallet. This, although unusual, is worthy of some explanation. Its realisation is directly ordained by the nature of the goods to which handling and packaging experts rarely give attention.

Very often during the designing of an article or a product a slight modification would be sufficient to engender handling, storing and transportation economies. For instance, restaurant stools are designed to be piled up one on top of the other in the least space possible, and following the same lines, experts should turn their attention to this aspect of the problem. Thus the systematic piling of goods with the least possible amount of interim support could be carried out without extra cost.

With a little luck and a lot of imagination, this principle can be applied to numerous types of products without the use of equipment other than that used for normal handling; metal ingots and steel pipes, for example.

Transport Conditions

The packaging has not only to be sufficient to withstand normal stacking, but also lateral pressure, which is sometimes considerable. This occurs during the sudden braking of trains or lorries and during the pitching or rolling of ships. In addition, in the course of transportation the packages and their contents are submitted to vibration and shaking which can last for hours, days and even weeks.

Apart from mechanical requirement, packaging is also subjected to lower or higher temperatures. In unventilated ships' holds in the tropics it can rise to 140°F. On station platforms on the equator, it can reach 120° F. and in closed trucks 100 to 120°F. Finally, the destination of the goods (hot, humid or dry regions and cold regions) and the number of transhipments and handlings also determine the characteristics of the packaging.

The few principles mentioned have, it is hoped, underlined the importance of uniting closely the studies of handling, packaging and transportation. They have also shown that the problems set by packaging are complex and that their solution necessitates being well informed, not only of the different risks, but also of the materials and techniques of packaging. The latter, while assuring an efficient protection of the goods, must in addition remain reasonably priced.

When choosing packaging, the following should also be taken into account:—

(a) the intrinsic or utilitarian value of the goods (for example, fire-clay bricks for the Congo);
(b) the fragility of the product (0% damage);
(c) its nature (machinery, corrosive products, explosives, rapidly evaporating materials);
(d) the number of packages of the same type which will be despatched (singly or in groups);
(e) the legislation in force in certain countries where payment per gross weight is made on imports.

The first question is to know if there is a means of carrying out practical and efficient packaging which is not prohibitive in price. At the present time one can reply "yes," since neither materials nor packaging techniques are lacking.

The second question is: how to produce a packaging which conforms to the desired aim.

In packaging two separate operations must be distinguished: firstly, the conditioning of the article or product and secondly, the final wrapping.

A. **Protection** against damp includes also the phenomena of corrosion, fermentation, melting, etc.

Firstly, there is the whole range of temporary protective agents such as hard and soft films and special anti-corrosion oil. Then come papers covered with volatile anti-corrosion agents, peelable plastics such as ethyl or acetobutyrate of cellulose: plastic films proper, such as polyethylene, polychlorure of vinylidene, copolymere of polyvinyle, etc., and complexes sealable by heat or not (aluminium, plastic, tarlatan, glazed paper, self-moulding fabric, bitumized papers, oil papers, etc.); so-called liquid envelopes used simultaneously with drying agents. For goods sensitive to damp a vacuum is made in the envelope.

Here an important observation should be made:

All the preceding can be efficient on the condition that they are carefully chosen and applied. On the pretext of protecting against damp, for example, worse damage must not be caused by the incompatibility of the product to be protected with the protective agent.

B. Protection Against Shock and Vibration

According to the product to be packed, there is no lack of materials for wedging or padding, but judicious use is necessary. Elasticity of behaviour under the influence of temperature, humidity, giving beneath shocks, vibrations, etc. must be reckoned with, for an empty space can be created and become the origin of damage.

C. Protection Against Insects

Numerous products exist on the market, such as pentachlorophenol, hexachlorophenol, pentachlorophenate, naphtenate of copper and zinc, etc.

(a) **Wooden packaging:** nailed and framed packing cases—wrapped or unwrapped—cases of reinforced wood, plywood, etc.

The construction of these has to comply with certain standards if strong packagings are to be effected with the minimum of material. The type of wood, its assembly, the arrangement of the reinforcing battens, the nailing, are amongst the many elements which play an important part in the final quality of the case.

(b) **Cardboard packaging**

Packaging of this type is much criticised in the tropics, but can nevertheless be used with success, provided that it is of good quality. Compact cardboard covered with bituminized paper stands up very well to tropical climate. The same applies to corrugated paper made of " Kraft " or " Wet-strength." Even cardboard made from pulp, although of lower quality, can be used for certain specific purposes. Its resistance to damp can be strengthened by various treatments such as paraffining, coating with a film of plastic, etc.

Nowadays it is possible to render both compact and corrugated cardboard waterproof at a very reasonable price by treatment with synthetic resins.

(c) **Jute packaging**

This is used a great deal for numerous products and is now made with a lining or coating of polyethylene.

The quality of the material must also be tested; that is, the number of threads, their resistance to traction, and above all, the sewing. It is no use using a sack of good quality material if the sewing is inadequate. Considerable damage can result exclusively from bad sewing, either with stitches too wide apart, or the thread itself too weak or of a kind that cuts through the jute thread. (Jute sacks sewn with sewing cotton have been presented for transport).

For storing in tropical atmospheres, it is advisable to use material which has been treated against mould.

(d) **Various metallic packagings**

Drums, cans, etc., coated with resin or with an internal plastic case.

(e) **Plastic or synthetic yarn packagings**

Large and medium sized sacks; polyester tanks; flexible containers of many cubic metres in nylon with various coverings, for the transport of oil, petrol, etc.

With these few examples we have tried to show that the modern packaging industry can supply all the materials and accessories (gummed tape, adhesives, etc.) which are indispensable in the carrying out of rational and efficient packaging for the consignment of products overseas.

We have been obliged to limit the problems which the packaging of products for export set, but before closing should like to draw attention to this last point:—

The Marking of Packages

This is particularly neglected and often causes considerable delay in the progress of the package. Some essential rules of good sense should at all costs be observed:

(1) The marking must be indelible. Obliteration of the address owing to the action of water or humidity should not occur. Avoid the use of labels fixed to the package by a piece of string. Most of the time they are torn off during handling operations.

(2) The address should be put on the sides of the package in easily seen places. It should not be on the bottom of the case, particularly when this bears the words " top " and " bottom."

(3) The address should be short and easily readable. Use large enough lettering. Do not overprint the packages with numerous inscriptions which complicate the task of the transporter.

(4) Use conventional signs to indicate " top," " bottom," " fragile," etc.

Any instructions put on packages destined for countries where they do not speak the same language are a waste of time. Port workers are not learned. Clear and precise pictures are the only effective means.

Port of Benghazi Reconstruction

The Port of Benghazi was constructed in the early 1930's by the Italians when they were developing their show Colony in Libya. The Port of Tripoli in western Libya had up till then been the main gateway into the Colony and it was planned to make Benghazi a port which would assist in the development of the eastern half of Libya known as Cyrenaica. Though the main breakwater structures were complete at the beginning of the 1939-1945 war only a limited number of quays were available.

The complete cessation of all maintenance and repairs to the various works constituting the Port of Benghazi during the war years resulted in a considerable amount of damage being caused, in particular to the main protective breakwater. This damage also resulted in the harbour becoming silted up to such an extent that it virtually ceased to exist as a deep sea harbour.

The Libyan Authorities have made various attempts at organising repair works and schemes were prepared by the Consulting Engineers Sir William Halcrow and Partners in 1954, 1956 and 1957. Unfortunately the economy of Libya did not provide sufficient funds for the comparatively expensive works being put in hand. The World Bank also made certain proposals in 1959.

The recent development in Libya of a number of oil fields has given the country the prospect of a much more secure economic future and the Government have felt that they could now embark on the reconstruction of Benghazi Harbour with reasonable confidence.

It was therefore decided during the early part of 1960 to invite tenders from experienced contractors in Europe and America for a scheme to restore the harbour for normal commercial operation. The Contract was awarded to a Greek Consortium consisting of the Archimedes Construction Co., and Odon and Odostromaton Construction Co., both of Athens and specially experienced in Mediterranean harbour works, and arrangements are at present being made by these companies to assemble plant and equipment at Benghazi with a view to making an early start on construction.

The works included in the Contract consist of the reconstruction of the outer mole using rock filling and concrete blocks, the lengthening of the Guiliana Mole in order to reduce the entrance width of 700-ft. and the construction of a quay 1,050-ft. long by 50-ft. wide which will consist of a reinforced concrete deck supported by steel piles. Provision is also made for an oil berth giving 26-ft. depth of water alongside. Arrangements are also made under the Contract for dredging to be carried out to enable ships of 25,000 tons to berth at the quay and for all the siltation which has occurred over the year since the port was in full use to be removed.

A distinctive aspect of the Contract for the Benghazi Harbour Reconstruction was that Contractors were asked to submit their own proposals for financing the payment of the works over a period of nine years.

Rubber Fenders for Piers and Docks

Review of Developments During Last Decade*

By A. R. SMEE, C.B.E., M.I.C.E.

The use of rubber in pier and dockside fender systems has shown a marked increase since the first articles on this subject appeared in "Rubber Developments" in 1953 and 1954. This is attributable to two factors—the ever-rising cost of repairs to both ships and wharves and the knowledge that rubber, when correctly compounded and correctly applied, has given ample proof of its ability to provide a high degree of protection with a minimum of maintenance and depreciation charges.

On docks and jetties throughout the world there is now a wealth of information available on the behaviour of rubber fender units under every variety of climatic and working conditions enabling reasonably accurate assessments to be made of costs of installation and expectation of life. From the design point of view scientific knowledge of the characteristics of rubber is now such that the engineer can incorporate rubber components into his projects with the same confidence with which he uses steel or other old and tried materials. It is possible, therefore, to design rubber fender systems where the behaviour of the rubber units is precisely known, i.e. its deflection under load and its energy-absorbing capabilities.

One further development deserves notice—the immense improvement in the abrasion-resisting qualities of rubber which has taken place in comparatively recent years.

All road users whose experience dates back to before the last war know how greatly the expectation of life of car tyres has been extended, despite higher speeds, faster acceleration and better braking, and this improvement in wearing qualities is of material importance in those fender systems where rubber is used in direct contact between the ship and the working face of the quay.

Fig. 1. Combination of tubular and rectangular fenders on a jetty in Venezuela.

Tubular Fenders

This type of fendering, comprising hollow tubular or rectangular rubber sections secured to the face of the quay or dockside by wires or chains threaded through the bore, is steadily gaining in popularity due to its simplicity of installation, the degree of cushioning provided and to the ease and cheapness of maintenance. Immune from attack by either termite or teredo, not subject to mildew or rot and far more resistant to abrasion than timber, a good case can be made out for the claim that, despite first costs, this type of fendering will, over the years, more than pay its way by cutting labour and material costs on routine maintenance.

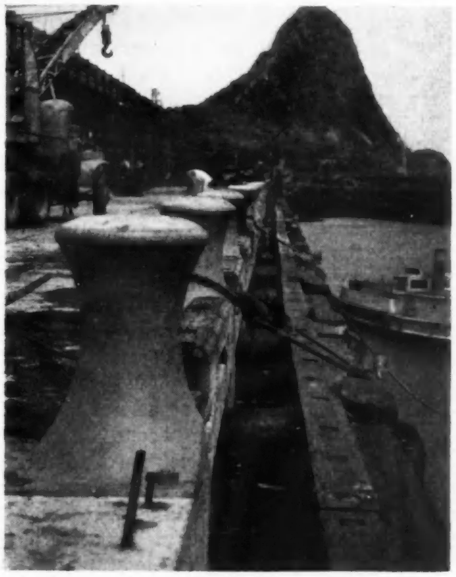


Fig. 2. Rubber buffers at new wharf installation at Port Taranaki, near New Plymouth, New Zealand.

Made in lengths of up to 13-ft. 6-in. and with outside diameters ranging up to 15-in., the tubular fender can be compressed to a third of its original diameter, i.e. a fender 15-in. section will give 10-in. of resilience and, since there is no initial inertia to be overcome this resilience comes into play immediately the ship makes contact. The generally recommended arrangement for tubular fendering is to sling it to the quay face at an angle of 45 deg. arranging the units so that the bottom end of one unit shows a vertical overlap on the top end of the adjacent unit.

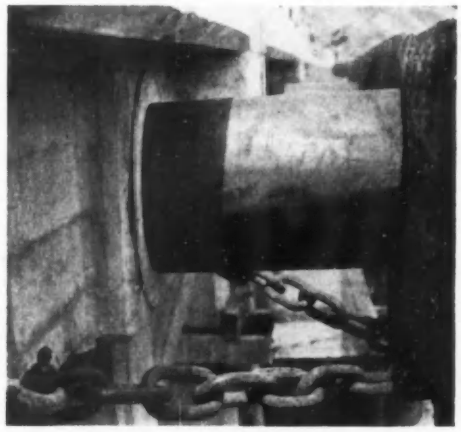


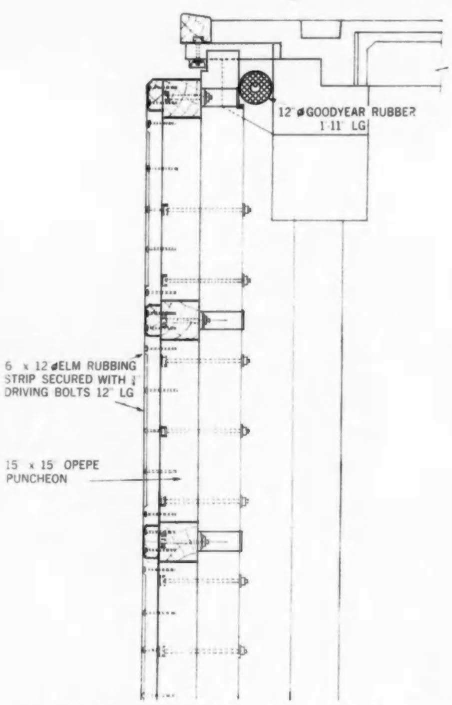
Fig. 3. Close-up of rubber buffer at Port Taranaki.

This arrangement ensures continuous overall protection along the whole of the working face of the quay and also makes certain that the ships' frames bear on the fenders rather than on the plating between them.

This type of fendering can be arranged in duplicate if so required and Fig. 1 shows a combination of tubular and rectangular Goodyear fenders supplied to three 1,000-ft. long piers in Venezuela, where 60,000-ton oil tankers will berth. Whereas 10 years ago Goodyear fender material was being used in three countries only it is now in use in over 90. This gives a good idea of its increasing use.

Besides its employment directly between ship and quay tubular rubber sections can be used as the energy-absorbing or cushioning media in a number of other applications. A good example of this is found in the new Moturoa Wharf, Port Taranaki, near New Plymouth, on North Island, New Zealand. Largely concerned with the handling of imported phosphates and the export of meat and dairy produce Port Taranaki is New Zealand's fifth port in order of ton-

*Reprinted from "Rubber Development," Vol. 13, Nos. 2 and 3, 1960, by kind permission of the author and the National Rubber Bureau.



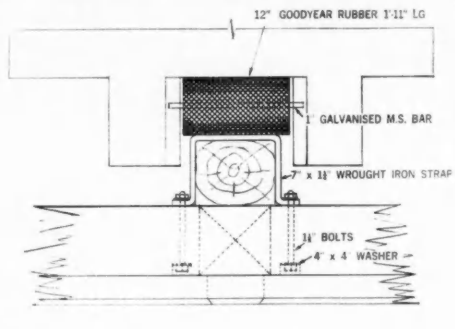


Fig. 4. Sectional elevation (above) and plan of fender installation (right) at Riverside Quay, Hull, showing positioning of the rubber units.

nage of goods handled. Originally constructed of timber in 1885 and subject to various alterations and additions its condition was such in 1953 that complete reconstruction was called for. Situated on the West coast, subject to winds of great violence and protected only by a breakwater, the type of new structure and the fendering system to be employed were closely studied to ensure freedom from damage to both ships and wharf. Reinforced concrete construction was decided upon with a fender system dependent upon the use of rubber in compression.

The eastern side only of the new wharf is intended for ocean-going vessels and the general layout of the fender system decided upon by the consulting engineer, Mr. W. G. Morrison, O.B.E., can be seen in Fig. 2, while Fig. 3 shows in detail how the rubber buffers are employed.

The design is notable for its simplicity and workmanlike appearance. A row of free standing piles is secured at its upper end to a waling running the length of the wharf and this in turn thrusts against a series of tubular rubber fender sections each 27-in. long, 18-in. outside diameter and 8-in. inside diameter. These rubber units are positioned by short spigots fitting into the bore at either end and the unit itself initially is put into compression by the pull of the anchorage chains. There is no possibility therefore of the walings and pile springing outwards and so allowing the rubber buffers to fall out of position.

The buffers illustrated were manufactured in Auckland by the Reid Rubber Co. and were built up to the required dimension by a process of wrapping thin sheets of rubber on a heated cylinder. They were required to stand compression up to 60% with a load of approximately 60 tons and before going into production a trial buffer was compressed 175 times without damage. On the western side of the wharf the fender system is similar to that on the eastern side but scaled down for the smaller vessels which will berth there. The buffers used are standard Goodyear extruded sections 21-in. long by 15-in. outside diameter and with a bore of 7½-in. diameter.

The Riverside Quay and South Side of Albert Dock, Hull

The Riverside Quay and south side of Albert Dock, Hull, has recently been reconstructed to the design of Sir Bruce White, Wolfe Barry & Partners, consulting engineers for the British Transport Commission, Humber Ports.

The system of fendering adopted for this scheme is straightforward and devoid of any linkage or mechanical parts requiring maintenance or servicing.

Fig. 4 shows in elevation and plan the layout which consists of free standing piles to which horizontal waling is attached, the whole faced with elm rubbing-strips. Behind each pile head and recessed into the coping of the quay is a section of tubular Goodyear fender 1-ft. 11-in. long by 12-in. outside diameter supported on a 1-in. diameter galvanised mild steel cross bar carried on a narrow sill either side on which it is free to move in and out to conform to the movements of the pile head. Good distribution of the load is ensured by the horizontal walings while the fender section will provide 8-in. of resilience.

Rubber Buffer System

Described as the "first giant tanker terminal in Europe" British Petroleum Co. Ltd. in June opened a new oil tanker jetty at Finnart on Loch Long designed to accommodate the 40,000-ton tankers at present in commission, the 65,000-ton tankers now building and the 100,000-ton tankers projected for the future. Loch Long is situated on the West Coast of Scotland and slightly north of Glasgow and the loch itself opens into the Firth of Clyde, its selection as a great oil terminal being dictated by the deep water and good anchorage facilities available.

Some 200-ft. from the shore and roughly parallel to it the superstructure of the new jetty is of reinforced concrete with a working face 330-ft. long and, in view of the size of vessel to be berthed, considerable importance is attached to the fender system to be employed.

The scheme was developed by the British Petroleum Co. Ltd. and incorporated fender units designed by Rendel, Palmer and Tritton, consulting engineers. The jetty face is provided with two main fender units located at 300-ft. centres, that is at either end of the jetty, and two secondary inner units spaced 164-ft. apart. Both types of fender are to the same general design and both operate on the same principle employing rubber buffers produced by Leyland and Birmingham Rubber Co. Ltd.

Figs. 5 and 6 illustrate in sectional elevation one of the main units at rest and also at full compression and show clearly the manner in which the fender operates and

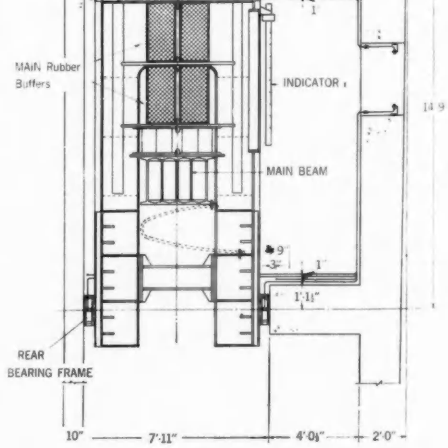


Fig. 5. Sectional elevation of rubber units at Finnart with the fender head in the "out" position.

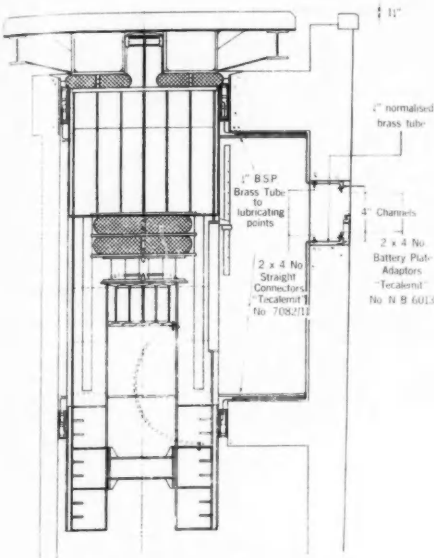


Fig. 6. Similar view of the units under extreme load with the rubber buffers at maximum compression.

how the rubber buffers are employed.

The outer face of the main unit consists of a steel-framed head 14-ft. square faced with timber. Behind this head are four rubber buffers each 20-in. in diameter and 20-in. long, which bear on the front plate of a box girder some 6-ft. 6-in. wide by 8-ft. deep. This box is free to slide in and out on phosphor-bronze bearings and contains within it two rubber blocks each 32-in. in diameter by 32-in. long arranged in tandem as shown and in turn bearing on an immensely powerful multi-steel joist fixed beam. The whole unit is given a slight initial compression by means of coupling chains between the jetty face and the fender head.

The four rubber buffers located behind the fender head receive, of course, the first shock or thrust from a ship coming in to berth and the attachment of the head is such that it can swivel slightly in both planes to take up any angularity caused by the angle of approach of the ship or any movement out of the vertical.

Total in-and-out movement of the whole unit is slightly under 4-ft. 6-in. and it has a maximum energy absorption of 7,000-in. tons.

The secondary fender units are slightly smaller, having a head 14-ft. deep by 10-ft. wide and backed by two rubber buffers only. The main buffer within the box girder consists of one rubber unit 22½-in. in diameter by 33-in. long, each unit having a total capacity of 2,800-in. tons.

The whole fender system of the jetty is considered ample to accommodate a 100,000-ton deadweight tanker. Apart from the Finnart Oil Terminal, rubber fender blocks have been installed at many new jetties during the last few years including the Kent Refinery, Isle of Grain in England, at Aden Refinery, in the Aden Protectorate, Kwinana Refinery at Fremantle in Australia, Mashur Jetties on the Persian Gulf, and Thames Haven Jetties, London, and engineers interested in the design of fender systems may find the accompanying table useful as showing the energy capacities at 50% and 60% compression of typical sizes of blocks that can be supplied. Further information including load compression curves applying to all sizes of simple cylinders of length to diameter ratio 1 : 1 and 3 : 2 is available from the manufacturers.

As the apex of the V is thrust inwards the rubber components are stressed in both shear and compression while it can be readily seen that the flexibility of the unit is such that it will yield to either a direct or glancing impact.

The length, height and deflection of the unit are governed by the number of sandwiches per side, each sandwich giving 3-in. of deflection. Manufactured in four widths and with a range of one to ten sandwiches the Raykin fender can be supplied to provide a cushioning movement of from 3 to 30-in. while the energy absorption per unit varies from a modest 2.5-ft. tons to the very high figure of 77.4-ft. tons, the energy absorption factor being about 0.580.

TABLE

Length (in.)	Diameter (in.)	Type of compression	Energy absorbed (in.) tons compression		Thrust on jetty tons compression	
			50%	60%	50%	60%
10	10	Axial	35	63	19	42
		Radial	26	48	15	34
15	15	Axial	120	210	42	95
		Radial	88	160	34	75
20	20	Axial	280	500	74	170
		Radial	210	380	61	130
30	20	Axial	420	730	72	160
		Radial	310	580	91	200
30	30	Axial	940	1,700	170	380
54	36	Axial	2,400	4,200	230	520
72	48	Axial	5,700	10,000	420	930

Energy capacities of typical rubber buffer blocks.

The Raykin Fender

Notable among what may be described as "standardised" fender units is the Raykin for which the Andre Rubber Co. hold the U.K. manufacturing rights. The method of construction consists of a series of "sandwiches" of rubber bonded between steel plates to form a V-type assembly—the apex of the V being the seaward face and mounting the fender pile, waling or rubbing piece according to the design of the jetty concerned.

A recent visit to the works of the Andre Rubber Co. on the Kingston By-Pass afforded the opportunity of seeing one of these units on test. Built for installation at Kharg Island in the Persian Gulf for the Iranian Oil Exploration and Producing Corporation this particular unit (which is one of over 400) has eight sandwiches each side and will accept a load of 48 tons with a resulting deflection of 24-in. (Fig. 7).

It was certainly impressive to see a hydraulic ram force the apex of the V down

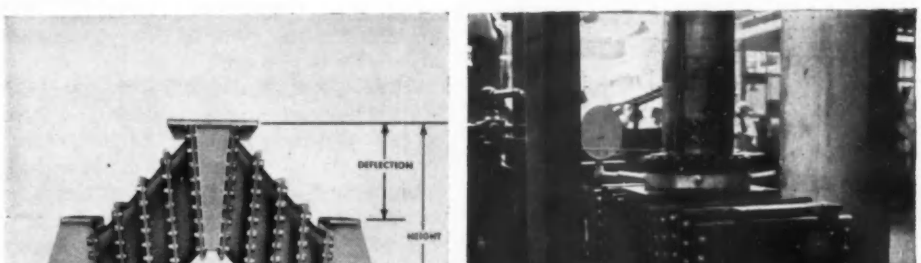


Fig. 7. (left) Diagram of the Raykin fender unit and (right) the unit in test rig under full compression at the Andre Rubber Co.'s works at Surbiton, Surrey.

until the whole unit was literally flattened out at maximum deflection.

With no moving parts requiring lubrication or, indeed, any attention, and all components adequately protected against corrosion and not subject to abrasion, the Raykin fender makes a considerable contribution to the protection of both ship and jetty.

Pneumatic Ships' Fenders

In a rather different class to the previous examples is a novel system of ships' fendering now under test in England which deserves notice.*

The advent of the large tanker has posed a number of problems of which a rather obvious one is the number of harbours where facilities do not exist for such vessels. A convenient solution to this problem is for the large vessel to lie off-shore while smaller tankers either fill or empty it, as the case may be. The difficulty is, of course, to give adequate protection to the two vessels lying side by side during the progress of the fuelling operation.

Designed by Marine Craft Constructors Ltd., of Victoria Street, London, their pneumatic fender is a very remarkable conception. It consists in brief of a hollow watertight shaft 38-ft. in length overall on which are mounted five wheels or rims to each of which is fitted a giant tubeless tyre. Fig. 8 shows the arrangement quite clearly.

The tyres themselves are approximately 10-ft. outside diameter and are inflated to a pressure of 50 p.s.i. The whole unit floats at roughly the level of the main shaft and two units are used where ships are lying together fuelling. Each unit is provided with two lifting eyes and the fenders can be carried by ship, or left at moorings and brought into position by tug as may be preferred.

As the wheels are mounted on Tufnol bearings they are free to rotate on the shaft and so can accommodate themselves to the relative movements of the two ships bearing against them. This ability to rotate will naturally reduce the wear on the tyre treads considerably, and eliminate damage through chafing of the ships' hulls.

The tyres themselves are manufactured by the Firestone Tyre and Rubber Co. Ltd., the wheels, which are of a non-corrosive alloy, were made by High Duty Alloys Ltd., of Slough, and the main shaft, which is of mild steel treated against corrosion, was built by Marshall Sons and Co. Ltd., Gainsborough, Lincolnshire. The complete unit weighs approximately 18 tons.

Appearances suggest that these fender units would afford a high degree of protection to ships anchored off-shore while engaged in fuelling operations.

*These trials have since been completed and further details will be found on a following page.

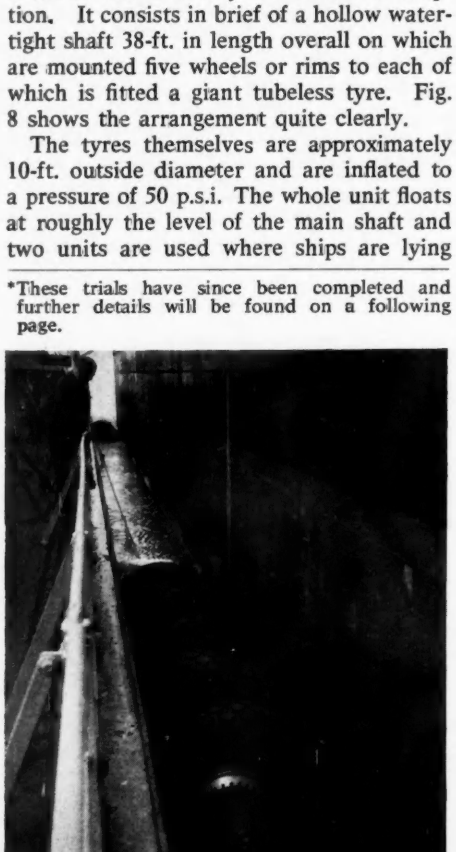


Fig. 8. Pneumatic fender in use between ships.

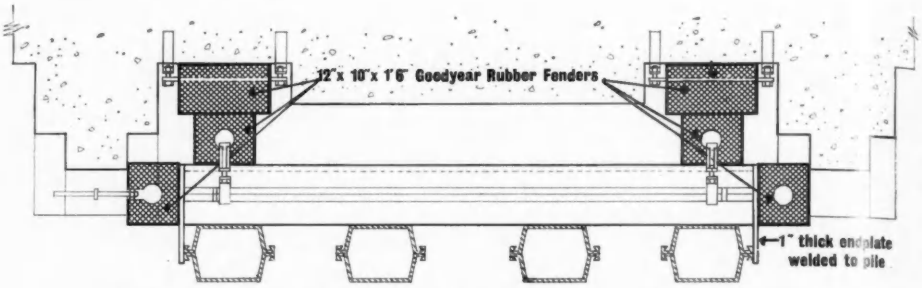


Fig. 9. Sectional plan of rubber fender installation at Penang Ferry Terminal. *(Courtesy—The Consulting Engineers, Sir Bruce White, Wolfe Barry and Partners)*

Penang Ferry Service

Declared open on September 23, 1959, by Tunku Abdul Rahman Putra Al-Haj, Prime Minister of the Federation of Malaya, the new ferry service between the island of Penang, and Butterworth on the mainland of Malaya, must rank as one of the most up-to-date in the world.

First started as a regular service in 1893-94, small steam launches proved adequate to deal with the passenger and goods traffic of that era but larger vessels were soon required and in 1946, 247,000 vehicles alone were transported. This figure rose to 711,000 by 1956, by which time the Penang Port Commission had proposals in hand for the provision of an entirely new ferry service.

Planning was undertaken by the Penang Harbour Board and its consulting engineers, Sir Bruce White, Wolfe Barry & Partners of London and included for new vessels, jetties, terminal buildings and that most necessary modern requirement, adequate road access and parking space.

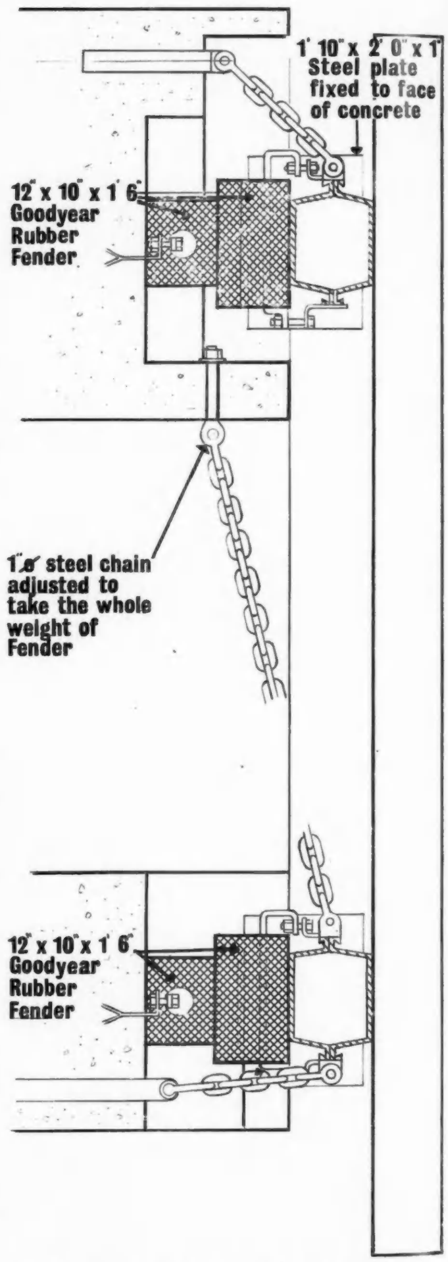


Fig. 10. Sectional elevation of fender installation at Penang Ferry Terminal. *(Courtesy—Sir Bruce White, Wolfe Barry Partners)*

Fig. 11. Penang Terminal showing the arrangement of fender units on the berthing jetty and dolphin, and the upper and lower drawbridges which provide access for passengers and transport to the ferry boat.
(Photograph by courtesy of the Goodyear Tyre & Rubber Co. (Gt Britain) Ltd.)

Both ferry terminals are generally similar in design consisting of steel framed buildings supported on a reinforced concrete substructure carried on concrete piles. Rapid handling of both passengers and vehicles is facilitated by their segregation —passengers embarking from the upper floor of the buildings on to the upper decks of the vessels and vehicles keeping to ground level and the lower decks.

The new vessels provided for the service are built for end loading and are of interest in that they incorporate the Voith-Schneider system of propulsion. This consists of a horizontal revolving disc let flush into the bottom of the ship and on which are mounted vertically downwards, four blades or knives. The angle of these can be altered as the disc revolves and full thrust can be exerted in any direction through 360°. With one such unit fitted at either end of the ferry boat the vessel can proceed ahead or astern with equal facility and also, move crab-fashion sideways as required. The berthing arrangements and fender system designed by the consulting engineers match the modern note of the rest of the terminal installation.

The berthing dolphin or jetty is a reinforced concrete structure approximately 150-ft. in length, the ferry boats coming in to either side as required. At the shore end the jetty splays out on both faces at an angle of about 30° and, distant some 25-ft. from either end, are individual dolphins roughly triangular shaped in plan, the arrangement being such that as the ferry boat comes to berth its bow noses into, and is held by, the two angular faces of the jetty end and the dolphin. Connection from ship to shore is by electrically operated drawbridges.

Figs. 9 and 10 illustrate the basis of the fender system. Four vertical steel box-pile sections each 14-ft. 2-in. long are welded to similar upper and lower horizontal pile sections to form a single unit. At either end of both horizontal components short lengths of Goodyear rectangular rubber fenders are fitted in a vertical position to the box piling by means of steel straps.

These fender sections back in turn on to similar rubber sections fixed horizontally to the concrete jetty structure as shown in the illustrations. In addition, the horizontal top and bottom box piles are blanked off at each end by steel plates and these bear on further rubber fender sections recessed into the concrete. The whole unit therefore not only provides resilience to direct thrust or impact but allows some degree of cushioned lateral movement considerably reducing wear and tear. The unit, as shown in the Sectional Elevation, is positioned and supported by a suitable arrangement of chains.

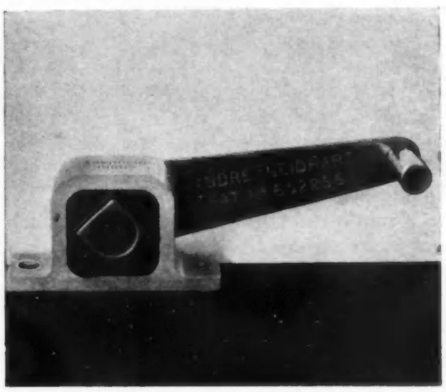


Fig. 12. Model showing Andre Neidhart shock absorber system.

With its passenger and vehicle handling facilities, the manœuvrability of its vessels and its berthing and fendering arrangements the Penang Port Commission have set a high standard in ferry operation.

Andre-Neidhart Shock Absorber

These shock absorbers, for which the Andre Rubber Co. Ltd. have sole manufacturing rights for the U.K. and Commonwealth and which make use of the system invented by the Swedish engineer H. J. Neidhart, have proved very successful.

Fig. 12 shows a demonstration unit which consists of a square box with rounded corners in which a square shaft attached to a lever arm is free to rotate. In each of the four corners of the box a rubber unit, originally circular in section, is inserted, which is pressed into a roughly triangular shape by the corners of the box and the face of the square shaft. If the lever actuating the shaft is moved in either direction, the

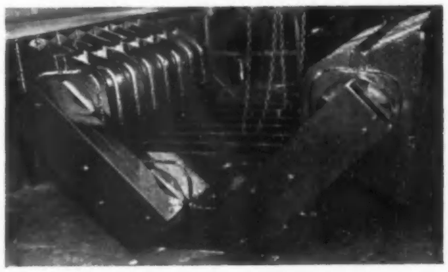


Fig. 13. Andre Neidhart fender installation under construction at the Andre Rubber Co., Surbiton, Surrey.

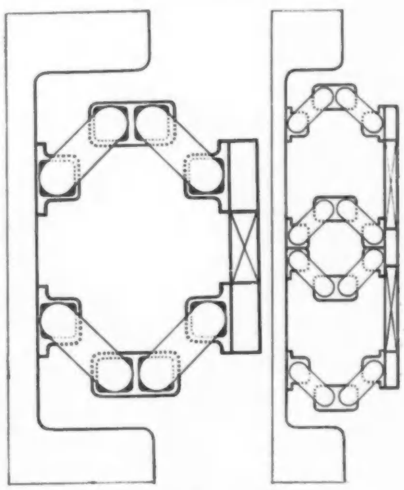


Fig. 14. Diagram illustrating two different applications of Andre Neidhart system to fender piling.

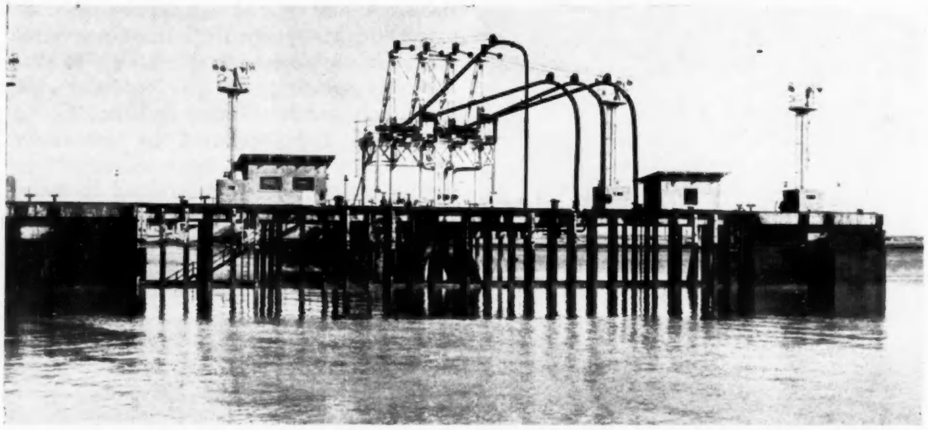


Fig. 15. One of the two oil terminal jetties at Mashur on the Persian Gulf showing the four fender units arranged in pairs at either end.
(Photograph by courtesy of the Consulting Engineers, Rendel Palmer and Tritton)

four rubber units are subjected to what may be described as "rolling compression," and resistance builds up rapidly. The stiffness of the unit is, of course, capable of wide variation, either in design of the metal parts, or by altering the Shore durometer hardness of the rubber.

The application of these shock absorbers to fender piles is shown in the diagrammatic sketch Fig. 14 from which it will be seen that the pile head is attached to the jetty structure by a system in which the lever arms of the shock absorbers form a linkage resulting in the operation of eight shock absorbers when the pile head is deflected. It will be noted, too, that the arrangement is such that the pile head will deflect under a glancing blow as well as one which is head on.

First installed in this country at the oil storage depot of the Regent Oil Co. Ltd., at Canvey Island in the Thames estuary, this fender system soon attracted attention by its effectiveness and has since been installed at the Mobile Oil Co.'s jetty at Corytown, also on the Thames estuary and at Falmouth Docks.

At present the Andre Rubber Co. Ltd. are fulfilling orders for 15 of these units for the Director General of Navy Work, Admiralty. Measuring overall 5-ft. 10-in. by 5-ft. 8-in., each unit has an energy absorbing capacity of 600-in. tons and is capable of deflecting $31\frac{3}{4}$-in. under maximum load.

Also in hand for the same Authority are smaller units of 72-in. tons capacity.

Oil Terminals

Earlier in this article, details were given of the fender system employed at Finnart, "the first giant tanker terminal in Europe," at Loch Long in Scotland, designed for ultimate use by the 100,000-ton tankers of the future. To an entirely different design are the fender systems devised by the same

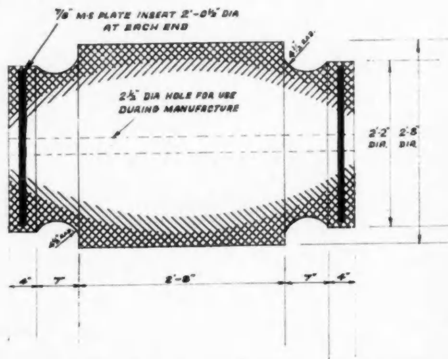


Fig. 16. Detail of rubber blocks manufactured by Leyland & Birmingham Rubber Co. Ltd., for use at Mashur Oil Terminal.

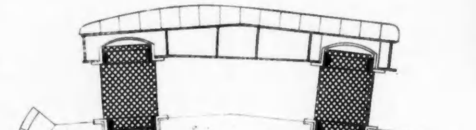


Fig. 17. Plan view showing how the rubber blocks are employed in the fender system at Mashur Oil Terminal.

firm of consulting engineers, Messrs. Rendel, Palmer and Tritton of London, for the 44,000-ton tankers plying between Bandar Mashur at the North end of the Persian Gulf and the Isle of Grain on the River Medway, near to its confluence with the Thames.

Of reinforced concrete construction, each terminal comprises two jetties each with a working face some 230-ft. long. Fig. 15 shows one such jetty at Mashur, although the photograph does not entirely take in its full width.

Two fender units are fitted at either jetty end each consisting of a timber-faced steel frame 16-ft. wide by 20-ft. deep and, incidentally, weighing some 20 tons. The cushioning is provided by large rubber blocks located at each corner of the unit and each of these blocks at the maximum compression of 20-in. (60%) will absorb 170-ft. tons.

Manufactured by the Leyland and Birmingham Rubber Co. Ltd., and detailed at Fig. 16, the body of the fender block is 2-ft. 8-in. long by 2-ft. 8-in. diameter and is throated at either end terminating in a flange 2-ft. 2-in. diameter in which is embedded a $\frac{7}{8}$-in. M.S. plate of 2-ft. $0\frac{1}{2}$-in. diameter.

The throat or waisted end of each block and its embedded steel plate, is to permit of it being gripped in a special split housing, one end of which forms part of the fender unit, the other end being recessed and fixed into the concrete of the jetty structure. Fig. 17 illustrates the arrangement, while the photograph at Fig. 18 which

Fig. 18. Fender unit at Mashur jetty being erected into position. The rubber blocks can clearly be seen between the concrete unit and the face of the jetty.

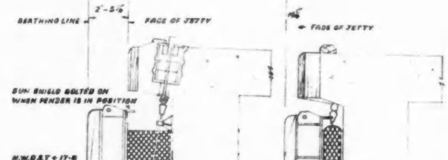


Fig. 19. Vertical cross-section through Mashur jetty fender unit showing method of suspension.
(Courtesy—Rendel Palmer & Tritton)

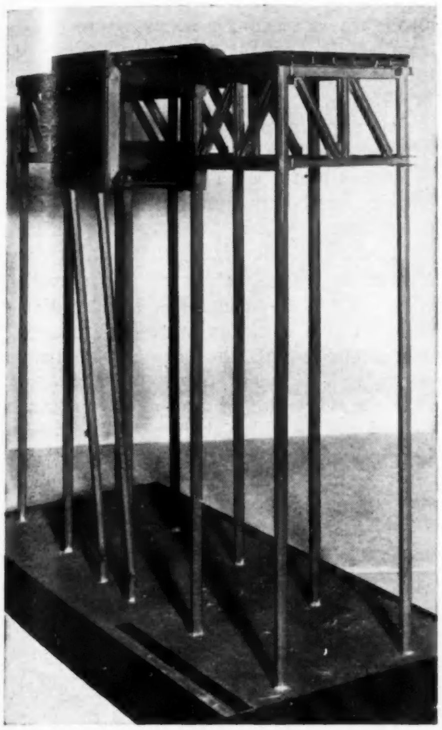


Fig. 20. Model of projected fender system under development by the consulting engineers for Mashur Oil Terminal

shows one of the fender units being slung into position during erection, gives a good overall picture of the size of the unit and its massive rubber buffers.

The weight of each unit is taken by two wire hangers which run up to suspension points in the jetty deck. These suspension points bear on 11-in. diameter rubber cushions which allow the whole fender unit to move vertically in conformity to the movement of the ship. Fig. 19, which is a cross-section through the fender unit, shows the simplicity of the suspension system employed which, incidentally, also permits the fender to move laterally. Cross chains limit this movement to 20-in. in either direction to prevent excessive shear distortion of the blocks.

Notable features of this design of fender are: The fender face can move in any plane to suit the varying shape of the ship's sides and its angle of approach. It provides smooth operation with comparatively large initial deflections for small applied loads and there is a complete absence of moving parts requiring maintenance.

Fig. 20 is a photograph taken in the offices of Messrs. Rendel, Palmer and Tritton of a model incorporating a fender system basically the same as that described above but differing in detail in that the weight of the fender unit is taken on two hinged piles, while anchorage chains are replaced by a system of linkage which allows considerable freedom of movement.

Floating Fenders

Built by World Fenders Ltd., the Tweddell Compression Fender is a floating catamaran available in a range of sizes from 10-ft. 6-in. long by 3-ft. 10-in. wide and 2-ft. 6-in. deep designed to cater for vessels up to 5,000 tons; to massive structures 27-ft. 6-in. long by 8-ft. 10-in. wide by 5-ft. 10-in. deep for use with vessels of from 50-100 thousand tons.

The fender normally floats about four-fifths submerged and irrespective of size, the basic design is the same consisting of rows of longitudinal baulks of timber between which are lines of Goodyear fendering material. In the intervals between the rubber fender units are heavy cross timbers which, by an ingenious inter-locking system, position the longitudinal baulks

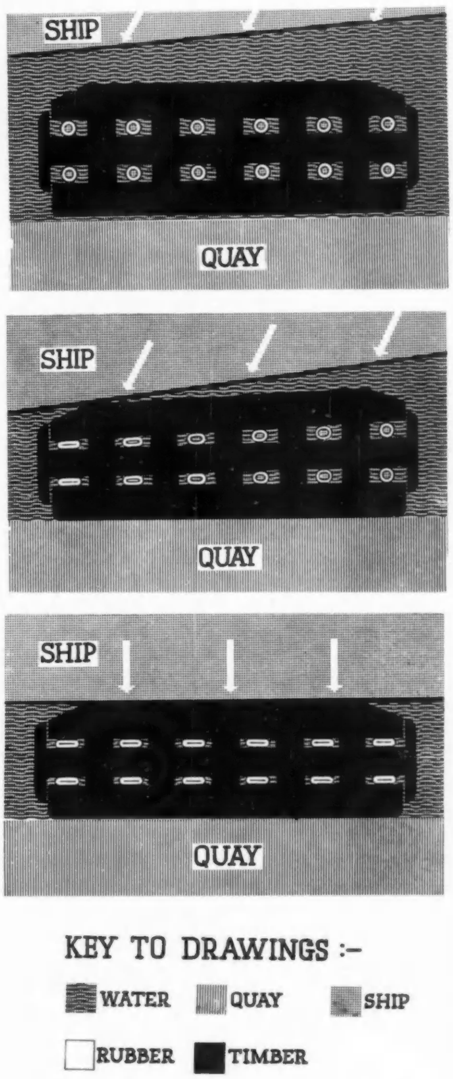


Fig. 21. Diagram illustrating the operation of the Tweddell floating compression fender. *(Courtesy—World Fenders Ltd.)*

but permit of their inward movement one towards the other. The outline sketches (Fig. 21) illustrate how the catamaran operates. As pressure is exerted between ship and quay the rubber units compress and the air and water contained in the bores is expelled and the rubber itself is finally under compression. As pressure is released the rubber units thrust the timbers outwards again, the whole catamaran therefore concertinas in and out. The range of compressive movement varies from 8 to 20-in. according to the size of the unit. A minimum of two fender units per ship is required. An advantage of this type of fender is, of course, that it can be shifted from berth to berth as required and requires no fixing other than mooring chains or ropes.

South Africa

The tubular rubber fendering adopted for the new harbour extension at Walvis Bay is of interest in that it was produced in the Union by the South African Rubber Manufacturing Co. Ltd., who supplied over 200 lengths each 12-in. outside diameter by 6-in. inside diameter and 13-ft. long.

Concerning these the manufacturers state: "These rubber fender blocks are carefully designed to withstand high compression and to resist the rigorous service conditions to which they are subjected. Compression up to 60% is normal but in emergency the rubber will compress to 75% without damage. Loads of up to $1\frac{1}{2}$ tons per sq. in. can be accommodated."

Fig. 22 shows the method of installation.

Fig. 22. Detail showing method of fixing tubular rubber fenders at the new harbour extension, Walvis Bay.

Reinforced Concrete Oil Jetties

A Description of Some Jetties Built for The Shell Company of Venezuela*

Introduction

Broadly speaking, oil-jetties may be of the T-shaped (or L-shaped) type, consisting of a platform running parallel to the shore and connected to it by a bridge-like approach structure, or of the "finger pier" type at right angles to the shore. Several varieties of each type are known. These structures may be built of steel, of concrete, or of a combination of these two materials. The choice of material will depend on local conditions and technical considerations. Where soil conditions are suitable for piling, a piled foundation may provide an economical solution. Difficulties have, however, been encountered with concrete mooring dolphins and similar structures of the kind consisting of a heavy concrete platform supported on reinforced concrete piles: in the event of damage to the piles, repairs are very difficult to effect. It may be advantageous to employ reinforced concrete caissons, because they are less vulnerable, but they require a firm base. On soils of lower bearing capacity, circular caissons constructed of steel sheet-piling may be employed.

Experience has shown that the most economical form of construction consists of a light piled jetty carrying the oil pipelines and the loading and discharging equipment. The vessels are moored to dolphins specifically designed for the purpose and installed alongside the jetty. In this way a functional division is obtained between the jetty and the mooring dolphins.

In general, the jetty should be so located that the tankers can be moored in a direction corresponding as closely as possible to that of the prevailing winds. The vessels are normally moored against the direction of the current. If the prevailing winds make it necessary to construct the jetty at right angles to the current, the force of the latter can be reduced by installing a screen of piles under the jetty.

Gaps of 20-30 m (65-100-ft.) should be provided between tankers moored one behind the other. The space between two vessels moored opposite each other, on either side of a waterway (as between two adjacent finger piers), should be not less than 50 m (165-ft.)

At the present time, mooring and berthing facilities designed for tankers of up to 75,000 tons deadweight are considered adequate to meet foreseeable future needs as regards the depth of water provided. Tankers of this size—which, for the time being, appears to represent a maximum from the viewpoint of overall operational economy—have a draught of 42-ft. 6-in. and require, in calm water, a depth of at least 44-ft. 6-in. below the lowest working water level. The structural design of jetties and dolphins is generally based on the method developed by P. Garde-Hansen and published in "The Dock & Harbour Authority", September, 1945. A maximum approach velocity of 25-30 cm/sec. (about 0.8-1-ft./sec.) at an angle of 20° to the face of the jetty is adopted in the calculations. The component at right angles to the face is considered, and the corresponding kinetic energy is multiplied by a factor of between 0.2 and 0.4 depending on considerations of safety and other factors. The component parallel to the face of the structure is generally of little consequence in the design of long jetties, but in the case of mooring dolphins it can produce torsion, which has to be taken into account. The magnitude of the torsional force will depend on the coefficient of friction between the vessel and the face of the dolphin.

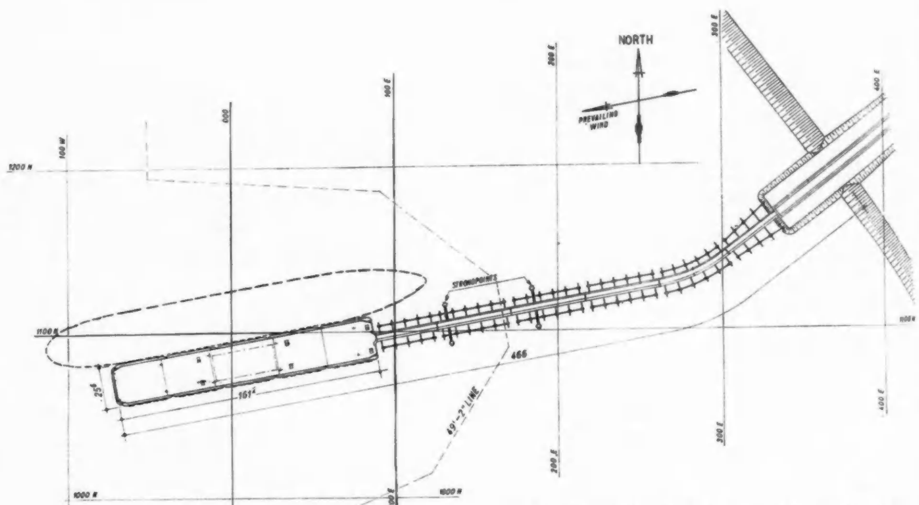


Fig. 1 Plan of oil jetty at Punta Cardón.

Jetty at Punta Cardón

The new jetty for the oil refinery of the Shell Company at Punta Cardón, in Venezuela, has been designed to provide berthing accommodation for tankers on an unprotected coastline. It was decided to construct a jetty that would be suitable for simultaneously taking two tankers of up to 65,000 tons deadweight, in open water, and it was accordingly necessary to have at least 46-ft. depth of water below the lowest water level. The jetty was built in 1958, at a cost of around £1,600,000.

Soil explorations revealed the presence of a firm stratum at a depth of 30 m (100-ft) below sea bed level. This stratum was overlaid by very soft material. Under these conditions it was decided to adopt a piled foundation. The axis of the jetty was aligned in the direction of the prevailing wind. The layout and the leading dimensions of the structure were determined in consultation with the shipping companies concerned. One of the requirements was that the jetty should present a continuous face alongside which the vessels could berth (as distinct from mooring against individual dolphins). Pulls of 125 tons in the mooring hawsers had to be allowed for. A further requirement was that motor vehicles, including lorries (carrying parts and equipment for effecting minor repairs to tankers), should be able to travel on the jetty.

The jetty head, which is connected to the shore by an approach structure, is about 160 m (525-ft.) long and 23 m (76-ft.) wide. Its deck is situated at the level +5.30 m (local datum=highest water level; lowest water level is −0.97 m). An approximately 20 m (66-ft.) wide horizontal lattice girder, of reinforced concrete construction, is installed at +2.15 m; its purpose is to distribute the horizontal forces exerted by vessels over all the raking piles on which this girder is supported. As these forces are resisted at the level of the pile heads, at a relatively small height above the water, the problem of berthing empty as well as fully laden tankers—i.e., vessels of widely varying freeboard depth—is simplified. The edge of the jetty deck itself is set back a short distance from the face of the struc-

* Based on an article by J. P. A. van Lookeren Campagne in "De Ingenieur," 24th June 1960.

ture and therefore does not take up any forces directly from the vessels berthing alongside.

The impact blows delivered by vessels berthing at the jetty are primarily taken up by horizontal concrete fender beams 32 m (105-ft.) long, 2.25 m (7-ft. 5-in.) wide and 1 m (3-ft. 3½-in.) deep. Five such beams are provided on each side of the jetty head; between them and the main structural system of the jetty are inserted seven Raykin shock absorbers per beam. These shock absorbers, which function as resilient bearings for the fender beams, are so designed that their resistance increases linearly with the deflection they undergo. (This deflection has a maximum permissible value of 12-in.). The energy to be absorbed by the fendering system is expressed by $E=\frac{1}{2}MV^2$ ton-metres. A value of 54,000 tons was adopted for the displacement tonnage of the vessels (corresponding to 65,000 tons deadweight), in conjunction with an assumed approach velocity of 0.30 m/sec. (about 1-ft./sec.). For an angle of approach of 20° the component perpendicular to the face of the jetty is 0.104 m/sec. Hence:

$$E=\frac{1}{2}\times\frac{54{,}000}{10}\times 0.104^2=29.2 \text{ tons-metres.}$$

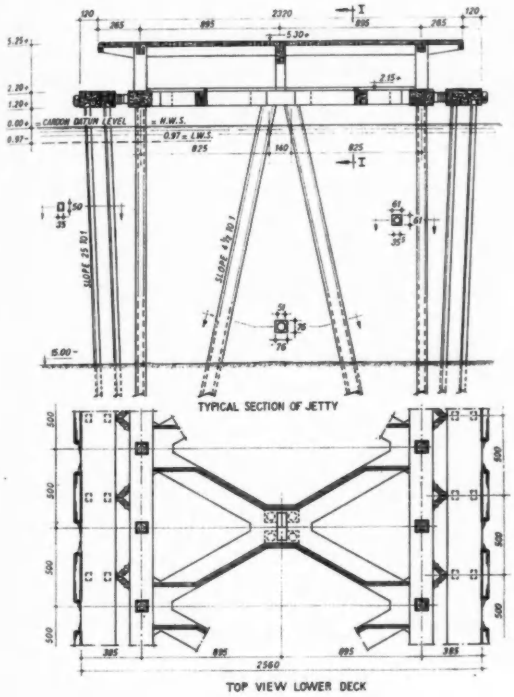
To obtain the amount of energy that the structure must absorb a factor of 0.4 is applied to the above value, giving $0.4\times 29.2=11.7$ ton-metres. This latter value is equated to $\frac{1}{2}PS$, where P is the force and S is the displacement of the system.

The resiliently mounted fender beams are protected by 15-in. diameter hollow rubber fenders suspended from chains. Each 32 m (105-ft.) long beam is supported on fifteen concrete piles of rectangular section, to which it is connected by hinged bearings so as to minimise the bending moment transmitted to the piles.

The main structural system of the jetty head comprises the above-mentioned horizontal lattice girder, which is supported on a system of raking piles (at 4½:1) and vertical piles. The latter are spaced 5 m (16-ft. 5-in.) apart, while the raking piles are arranged in four-pile bents at 10 m (32-ft. 10-in.) intervals along the jetty. The calculated maximum compressive load on a raking pile is 104 tons, and on a vertical pile it is 60 tons. The calculated maximum tensile load on a raking pile is 18 tons. The raking piles are made of prestressed concrete; they have a square section of 76 cm × 76-cm (30-in. × 30-in.) and are hollow, with a circular cavity of 51 cm (20-in.) diameter. The vertical piles are of 61 cm × 61 cm (24-in. × 24-in.) square section, with a cavity of 35 cm (13¾-in.) diameter. After the piles had been driven, a broad-flange rolled-steel section was inserted into the central cavity of each pile and grouted in. The pile heads were cut off at the level of the underside of the horizontal lattice girder; the projecting reinforcing bars of the piles were bent round and concreted into the girder.

The deck of the jetty head is supported on short columns. It is provided with three expansion joints—the girder itself, which is to some extent protected from extreme temperature variations by the deck, has none—and is equipped with bollards designed to withstand a maximum pull of 125 tons in any direction.

The approach structure linking the jetty head to the shore consists of a series of pile trestles carrying concrete cross-beams which in turn support the pipelines and superstructure. Two heavy tubular mooring dolphins are installed on either side of the approach structure. They provide subsidiary berthing accommodation and serve to protect the structure. These dolphins consist of Mannesmann steel tubes 36 m (118-ft.) in length and 1.70 m (5-ft. 7-in.) in diameter; their wall thickness varies from 28 to 40 mm (1.1 to 1.6-in.). The tubes were sent as single units from the factory in Germany to Venezuela and were installed by driving them into the sea bed. At the top, each tubular dolphin is provided with a reinforced concrete platform surmounted by a bollard made from a length of steel tube filled with concrete.



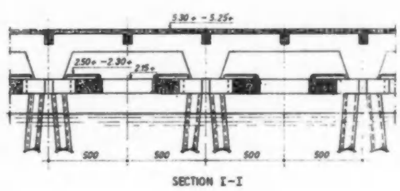
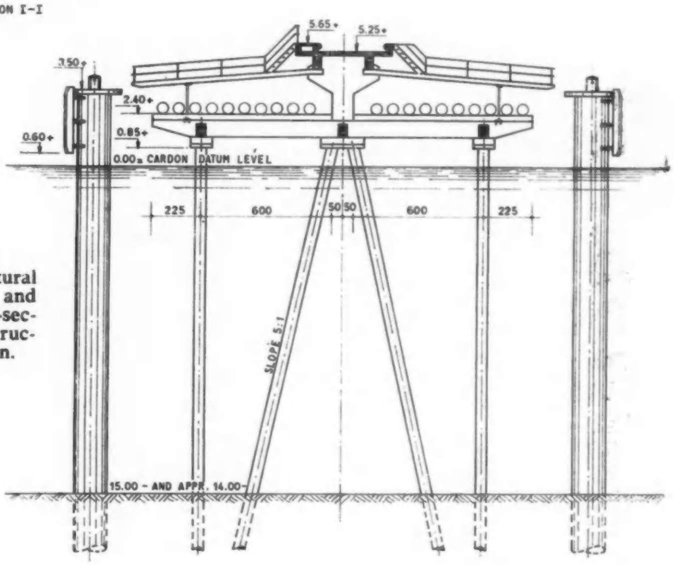


Fig. 2. (left) Structural details of oil jetty and Fig. 3 (right), Cross-section of approach structure at Punta Cardón.

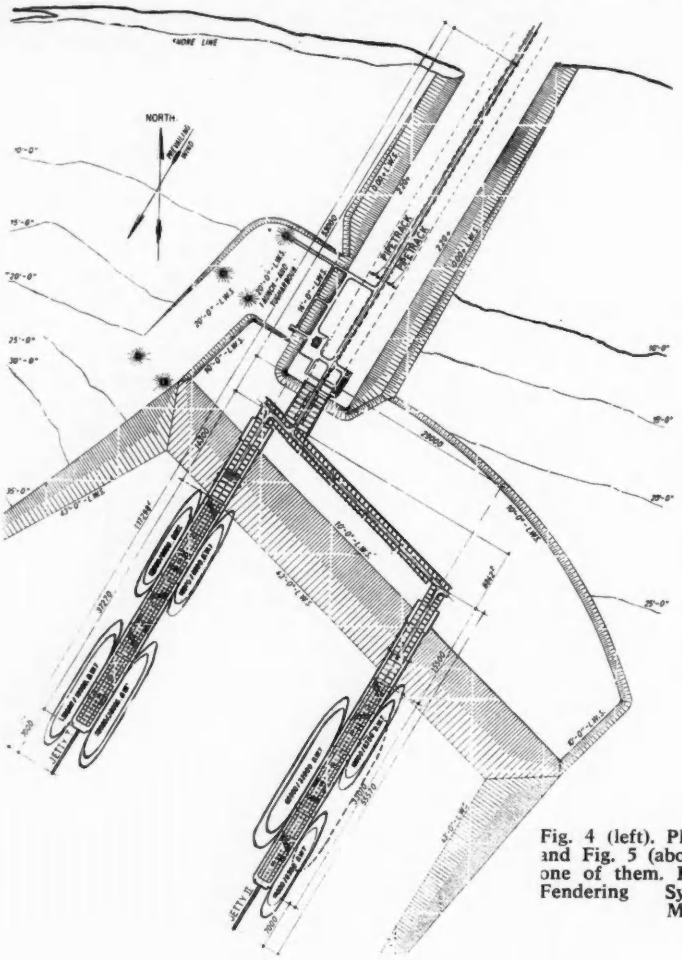


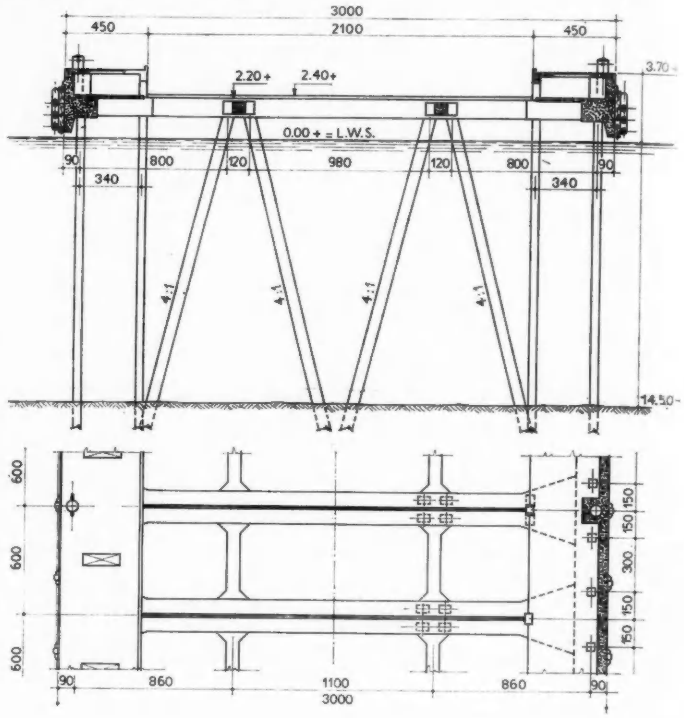
With the exception of the piles, all the structural concrete of the Punta Cardón oil jetty was treated with a protective coating consisting of a solution of one part of magnesium fluoride to three parts of water. It was brushed on in three coats at 24-hour intervals, the first coat being applied when the concrete was 7 days old.

Jetties at Puerto Miranda

Another and larger oil jetty system was built at Puerto Miranda, on Lake Maracaibo, Venezuela, in 1959, at a total cost of around £4,500,000.

Lake Maracaibo is in open connection with the sea. The entrance to the lake is relatively shallow, owing to the presence of a sand bar, and the required navigation depth has to be maintained by dredging. It





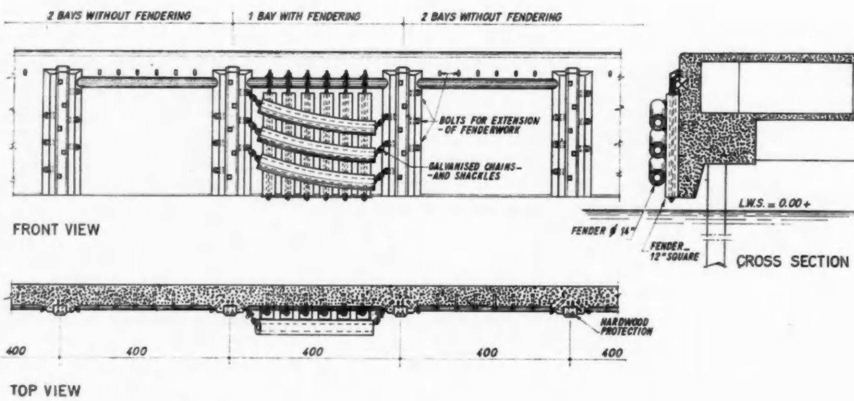


Fig. 4 (left). Plan of the oil jetties and Fig. 5 (above) Cross-section of one of them. Fig. 6 (bottom left). Fendering System at Puerto Miranda.

is intended eventually to increase the depth of the entrance channel sufficiently to permit tankers of 65,000 tons deadweight (with a draught of 42-ft. 6-in.) to enter and leave the lake. The new jetties have accordingly been designed to provide berthing facilities for vessels of this size. They consist of two finger pier type jetties, each capable of accommodating four vessels (two on either side). At their landward ends these jetties are connected by a transverse structure which can, if desired, subsequently be extended in both directions to provide access to additional jetties.

Soil explorations revealed the presence of a firm sand stratum at a depth of about 14 m (45-ft.) below water level. As at Punta Cardón, the structure was required to have a continuous face. Pulls of 100 and 150 tons in the mooring hawsers had to be taken into account. The structural design was again based on an approach velocity of 0.30 m/sec. at 20°; in this case, however, a factor of 0.3 was applied to the kinetic energy and the displacement tonnage of the berthing vesel was assumed at 62,000 tons (corresponding to a tanker of 65,000 deadweight sailing in ballast).

The two jetties are each about 370 m (1225-ft.) long, with expansion joints at the third points. The superstructure in each case consists of a horizontally placed Vierendeel type girder of reinforced concrete construction. The chords of these girders carry the roadways, while the pipelines are supported by the cross-beams. The horizontal girders perform, in the main, the same function as does the horizontal girder of the Punta Cardón jetty. The structure is carried on reinforced concrete piles arranged in trestles comprising vertical piles of 42 cm × 42 cm ($16\frac{1}{2}$-in. × $16\frac{1}{2}$-in.) square section and raking piles (at $4\frac{1}{2}$:1) of 60 cm × 42 cm ($23\frac{1}{2}$-in. × $16\frac{1}{2}$-in.) rectangular section. The maximum loads on a pile are about 60 tons compression and 7 tons tension.

Puerto Miranda is a more protected location than Punta Cardón, and a rather simpler and cheaper solution has accordingly been adopted for the fendering. This consists of square-section (12-in. × 12-in.) rubber fenders suspended vertically from steel chains on the jetty face. In front of this system of fenders is provided a second system consisting of 15-in. diameter tubular rubber fenders, each about 3 m (10-ft.) in length. The rubber fendering is not provided over the entire length of the jetty but only in every third 4 m (13-ft.) long bay of the jetty face.

Port Operation and Information Service, Southampton

Examples of the Practical Application of the Service

(Submitted by the Southampton Harbour Board)

IN January, 1958, the Rt. Hon. Harold Watkinson, M.P., Minister of Transport and Civil Aviation, inaugurated the Port Operation and Information Service at Calshot Signal Station. This service was introduced at the suggestion of the Chamber of Shipping of the United Kingdom and was fully described in the February 1958 issue of the "Dock and Harbour Authority". It fulfils two important functions. Firstly, it co-ordinates the movement of Tankers using the petroleum terminals with vessels proceeding to and from the Southampton Docks. Secondly, it provides information to individual vessels entering, berthing and leaving the port. To assist in these functions, a Decca Type 32 Harbour Radar with three viewing units (Fig. 1) and Radio-telephone equipment, supplied by Marconi's Wireless Telegraph Co., Ltd., and complying in all respects with The Hague Maritime V.H.F. Radio-telephone Agreement of 1957, have been installed. In addition to the Calling and Safety Channel No. 16, Calshot Radio maintains a continuous listening watch on the Working Channels Nos. 12, 20 and 22. The use of the two frequency channels Nos. 20 and 22 is intended to reduce unnecessary noise on the bridge of large ships, as the only broadcast speech to be heard on board will be that of the shore operator, when speaking to that ship. Information regarding the height of the tide, force and direction of the wind and visibility range is also available on request from Calshot Signal Station (Fig. 2).

Information regarding berthing and other arrangements at the Southampton Docks and the Esso Marine Terminal, Fawley, is the responsibility of the British Transport Commission and the Esso Petroleum Company, respectively. Provision is made within

Fig. 1. The Operations Room at Calshot Signal Station showing the console with the three viewing units. The Harbour Master, Capt. James Andrew, M.B.E., R.D. is on the right.

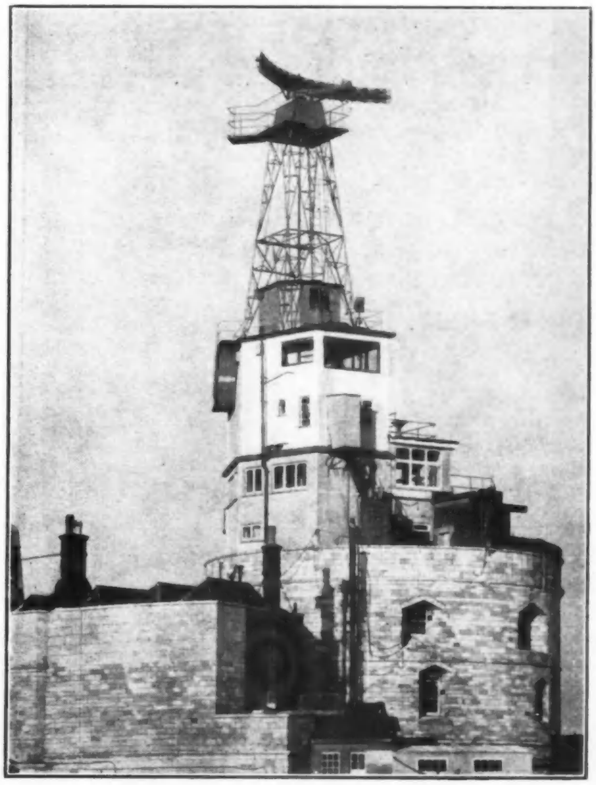


Fig. 2. Calshot Signal Station.

the Port V.H.F. R/T Communications System for direct contact with these authorities through the stations "Southampton Docks" and "Esso Fawley" on the Calling and Safety Channel No. 16, shifting to the Working Channels Nos. 14 or 18 in the case of "Southampton Docks" and Channel Nos. 14 or 19 with "Esso Fawley" for the exchange of messages.

In January, 1960, the second anniversary of the inauguration of the service, a number of vessels fitted with R/T equipment entered and sailed from the port and made good use of the service. A description of a selection of these movements, together with a diagrammatic chart (Fig. 3) and a transcription of the recorded R/T messages* passed, both V.H.F. and M/F, have been compiled. The Board are publishing these examples, as they may be of interest to Ship-owners when considering the fitting of their vessels with the appropriate V.H.F. R/T equipment and they might also be useful to Ship Masters, whose ships are already fitted, to demonstrate the practical use of this service. Other

*A Thermionic Automatic Magnetic Tape Recorder is installed in the Signal Station and records all R/T messages received and transmitted.

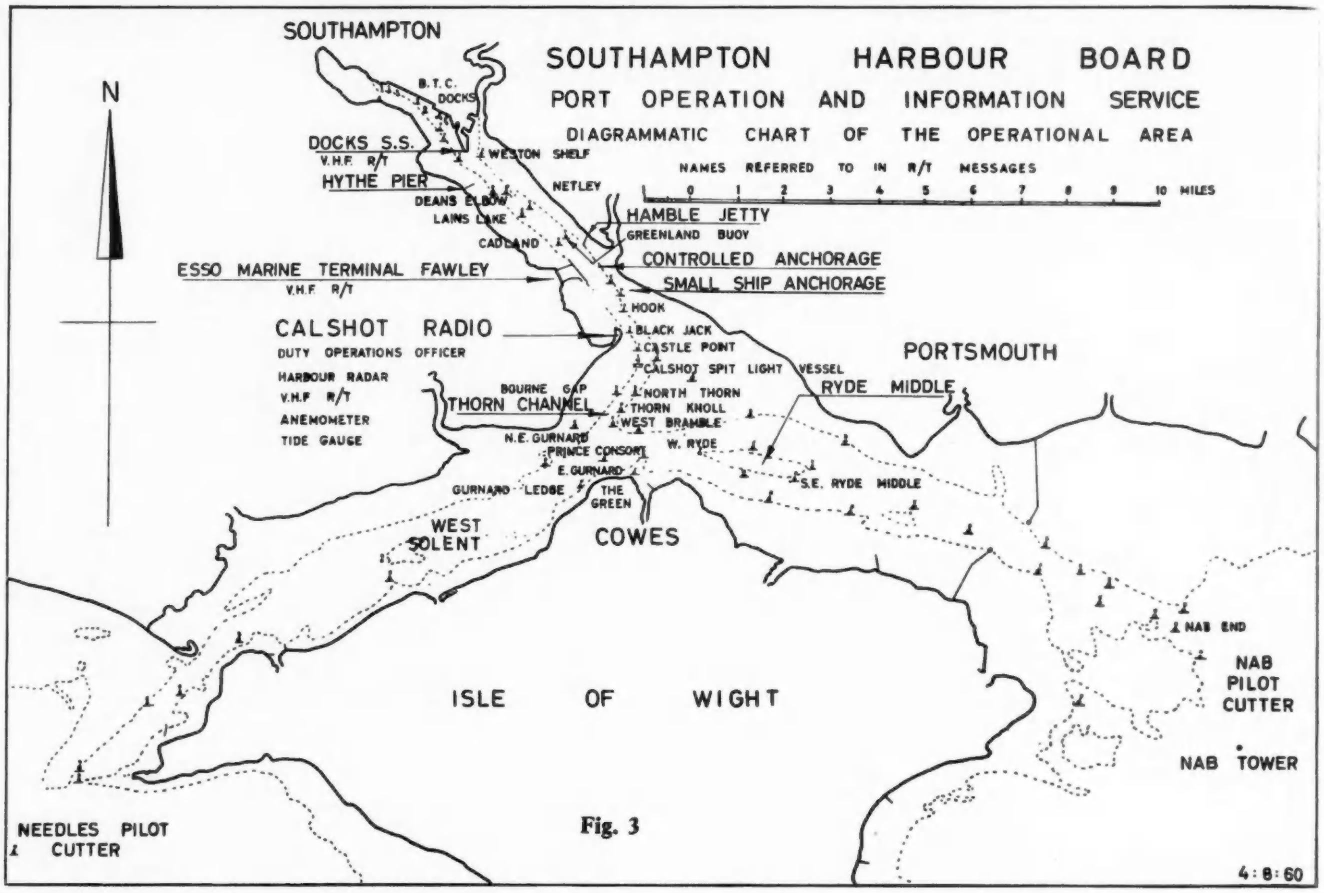


Fig. 3

ports may find these practical examples of help to them when contemplating the introduction of a similar Service. The transcriptions are factual and the marked degree of confidence that is being placed by Masters and Pilots in the Staff and equipment in Calshot Signal Station, is self evident.

It should be noted that originally the Southampton Harbour Board launch was equipped with M.F. Radio-telephone to facilitate harbour operations. When the V.H.F. Port Operations Scheme came into force in January, 1958, the Harbour Board retained the M.F. equipment temporarily in the launch to provide service with ships not equipped with V.H.F. After six months, it was agreed by the General Post Office that, for operational reasons, the M.F. equipment could be transferred to the Signal Station. This arrangement was made on a purely temporary basis, to allow a reasonable time for the fitting of V.H.F. equipment in ships. The M.F. equipment at Calshot Signal Station was withdrawn from service on the 1st April, 1960.

In the following examples, names of vessels have not been mentioned, but an indication of the size and type of vessel is given.

British Passenger Ship — Polish Passenger Ship — German Passenger Ship — Troopship
(Vessels between 14,000 and 35,000 Tons)
January, 1960

The following is a very good example of the team work that is most necessary when co-ordinating shipping movements and concerns two passenger vessels, one British and one Polish, outward bound from the Docks, a Troopship inward bound from the Needles and a German passenger ship from the Nab when visibility was approximately ½ a mile. Also the German passenger ship whose radar was unserviceable took the same berth as the British passenger ship was vacating. This close co-ordination would not have been possible if all four vessels were not in direct R/T communication with Calshot Signal Station. At the time these movements took place both V.H.F. and Medium Frequency R/T communications were used but this is now only possible using V.H.F. R/T.

The advantages of supplementing navigational information obtained from a vessel's own radar by information from the harbour radar is clearly demonstrated in this example. Of 23 listed exchanges between vessels and Calshot Signal Station, no less than 13, i.e. more than half, necessitated the use of the harbour radar.

The transcriptions open with the German ship at the Nab, the Polish ship from the Docks and the Troopship at the Needles establishing R/T contact with Calshot Signal Station. The Board attaches considerable importance to this initial contact and the following is an extract of the Board's current Notice to Mariners regarding the Port Operation and Information Service.

> "Vessels fitted with the appropriate V.H.F. R/T equipment are particularly requested to establish contact with Calshot Signal Station before sailing and on arrival when entering the Nab or Needles Channel, and inform the Operations Officer of the Master's intentions. In turn the Operations Officer will pass information of other shipping movements taking place in the Port and its approaches. A two-way exchange of information is an essential pre-requisite to efficient operations. The advisability of maintaining R/T contact with the Harbour Master cannot be over-emphasised, particularly in the event of unforseen circumstances developing in the Port area."

Subsequent exchanges of information between vessels and Calshot Signal Station enabled all ships to adjust their speed of

advance to keep the Thorn Channel clear for the two outward bound vessels and for the inward bound ships to enter this channel without being inconvenienced by another ship.

The importance of the Operations Officer in Calshot Station having up-to-the-minute information of all movements taking or about to take place within the Port and its approaches is brought out in this example.

Time	From	To	Message
1026	German Ship	Calshot Radio	I have just passed Nab End Buoy inwards, are the Polish Ship and the British Ship still sailing at 1000 ?
	Calshot Radio	German Ship	Both scheduled for 1030, the British Ship is going to proceed first.
	German Ship	Calshot Radio	Roger — Is my berthing time the same ?
	Calshot Radio	German Ship	I know of no change, stand by, I will check it with the Dockmaster.
	German Ship	Calshot Radio	Standing by.
1036	Polish Ship	Calshot Radio	This is the Pilot of the Polish Ship bound to Nab. Any movements ?
	Calshot Radio	Polish Ship	German Ship passing Nab End Buoy. Troopship passing Needles and will probably anchor in West Solent.
	Polish Ship	Calshot Radio	What is your visibility ?
	Calshot Radio	Polish Ship	$\frac{1}{2}$ mile.
	Polish Ship	Calshot Radio	Roger.
1041	Calshot Radio	German Ship	I have been informed that you can berth any time after 1230.
	German Ship	Calshot Radio	What is your visibility ?
	Calshot Radio	German Ship	$\frac{1}{4}$ to $\frac{1}{2}$ mile. The British Ship has just sailed. She is being closely followed by the Polish Ship. **(R).**
	German Ship	Calshot Radio	Thank you.
1106	German Ship	Calshot Radio	What is the position of the British Ship and the Polish Ship ? I am off the S.E. Ryde Middle (buoy).
	Calshot Radio	German Ship	The British Ship is passing Lains Lake (buoy)—the Polish Ship is passing Hythe Pier. **(R).**
	German Ship	Calshot Radio	Roger — any change in your visibility ?
	Calshot Radio	German Ship	No, still $\frac{1}{2}$ mile fairly steady.
	German Ship	Calshot Radio	Roger.
1119	Troopship	Calshot Radio	We embarked our Pilot at 1105 at the Needles and are proceeding up the West Solent—what is your visibility ?
	Calshot Radio	Troopship	Visibility at Calshot $\frac{1}{2}$ mile.
1123	German Ship	Calshot Radio	We are just passing W. Ryde Middle (buoy) — where is the British Ship please ?
	Calshot Radio	German Ship	The British Ship is passing Calshot Signal Station now. The Polish Ship is off No. 5 Berth, Fawley. The Troopship proceeding in from westward gives E.T.A. Calshot 1215 you should be all clear. **(R).**
	German Ship	Calshot Radio	Thank you. I will be coming up after these two have cleared the Thorn Channel.
	Calshot Radio	German Ship	Roger.
1125	Troopship	Calshot Radio	Can you please tell me if there are any movements to interfere with our arrival at the Thorn Channel at 1200 ?
	Calshot Radio	Troopship	You probably overhead my conversation with the German Ship. There are two vessels outward bound now and the German Ship inward, nothing else after that until 1400. **(R).**
	Troopship	Calshot Radio	Roger. We will follow German Ship up, what is your visibility ? — $1\frac{1}{2}$ miles here.
	Calshot Radio	Troopship	Roger, visibility 1 mile at Calshot.
1126	German Ship	Calshot Radio	Can you tell me if the Polish Ship is bound east or west ?
	Calshot Radio	German Ship	The Polish Ship and British Ship are both bound east. British Ship passing Calshot Spit Light Vessel. Polish Ship passing Calshot Signal Station. **(R).**
	German Ship	Calshot Radio	I am just off the Prince Consort buoy now.
	Calshot Radio	German Ship	Roger.
1130	Calshot Radio	British Ship	Please stand by. I have a message for you.
1131	Calshot Radio	German Ship	I have the British Ship on the R/T now will it be in order to tell her that you will wait until she is clear of Thorn Channel ?
	German Ship	Calshot Radio	Yes please, tell her I'll keep to the southward between the Prince Consort and E. Gurnard Buoys until she has come round West Bramble Buoy.
	Calshot Radio	German Ship	Roger.
1132	Calshot Radio	British Ship	From the Pilot of the German Ship—he intends to keep to the southward until you have rounded West Bramble Buoy and cleared the Thorn Channel—German Ship is now passing Prince Consort Buoy.
	British Ship	Calshot Radio	Roger.

(R) Harbour Radar Information.

Time	From	To	Message
1151	German Ship	Calshot Radio	Those two ships are clear of channel now, we are just turning in—is there anything else coming down please? **My radar is unserviceable.**
	Calshot Radio	German Ship	Roger, we have one small craft—a Red Funnel Steamer—just passing Castle Point Buoy, that is all the traffic moving at the moment. **(R).**
	German Ship	Calshot Radio	Roger—what is your visibility?
	Calshot Radio	German Ship	Visibility 6 to 8 cables.
1203	Calshot Radio	German Ship	A small tanker has just left Hamble Jetty outward bound via the Needles—the Thorn Channel is all clear for you—the patrol launch is passing North Thorn Buoy and two small vessels inward bound passing Castle Point Buoy. There is one vessel anchored in N.W. corner of Small Ship Anchorage tailing slightly in the Fairway. **(R).**
	German Ship	Calshot Radio	Roger.
1216	Troopship	Calshot Radio	I overheard you say a small vessel had left Hamble bound west — where is she now?
	Calshot Radio	Troopship	Now passing to the east of Hook Buoy. **(R).**
	Troopship	Calshot Radio	I am off Gurnard Ledge and will be a little late on our E.T.A.
	Calshot Radio	Troopship	Roger.
1217	Calshot Radio	German Ship	The small outward bound tanker is inside Hook Buoy on an easterly course and may well be going to anchor. **(R).**
	German Ship	Calshot Radio	Roger.
	Troopship	Calshot Radio	Where is the German Ship?
	Calshot Radio	Troopship	Now passing Black Jack Buoy. **(R).**
1225	Calshot Radio	Troopship	The small tanker which was outward bound has anchored in the Small Ship Anchorage. **(R).**
	Troopship	Calshot Radio	Roger.
1230	Troopship	Calshot Radio	We are now at the West Bramble Buoy, where is the German Ship and is the channel clear for me?
	Calshot Radio	Troopship	The Thorn Channel is all clear for you, there is a small vessel to northward of Calshot Buoy on a N.W.'ly course. The German Ship is passing No. 5 Berth Esso, and a small barge outward bound now passing Calshot. **(R).**
	Troopship	Calshot Radio	Roger.
1234	Calshot Radio	Troopship	Your Tender is on the way down with your Docking Pilot and will rendezvous off Fawley Jetties.
	Troopship	Calshot Radio	Roger.
1238	Calshot Radio	Troopship	The small inward bound vessel is now ½ mile N.E. of Castle Point Buoy, the small outward bound craft is approaching Castle Point Buoy on the Western edge of channel. **(R).**
	Troopship	Calshot Radio	Roger.
1239	Calshot Radio	German Ship	There are four small echoes outward bound on western side of channel between Lains Lake and Cadland Buoys. **(R).**
	German Ship	Calshot Radio	Roger.
1244	Calshot Radio	Troopship	For your information the German Ship is now passing Lains Lake Buoy. **(R).**
	Troopship	Calshot Radio	Roger.
1346	Troopship	Calshot Radio	Troopship is now in her berth, thank you for your very kind assistance which was much appreciated.
	Calshot Radio	Troopship	Thank you very much indeed.

Passenger Vessel—January, 1960

This large passenger ship arrived an hour late at the Nab Pilot Station and the Pilot requested berthing instructions. It was doubted whether this ship could berth in time before the "Queen Mary" sailed and arrangements were made for her to berth after the "Queen Mary" had departed and before the arrival of the "Queen Elizabeth". The visibility at the time was 2½ miles and a number of Tanker movements were also taking place. The progress of the inward movement of this vessel was made known by R/T and eventually she was able to berth before the "Queen Mary" sailed which probably would not have been possible had she not been fitted for direct R/T communication with Calshot Signal Station.

As this vessel was only fitted with medium frequency R/T all communications had to pass through Calshot Signal Station.

Time	From	To	Message
0642	Nab Pilot Cutter	Calshot Radio	(Pilot of the Large Passenger Vessel speaking.) This vessel is still about 3 miles off, the earliest I can be aboard is 7 o'clock which means E.T.A. Netley roughly 9 o'clock. I understand the "Queen Mary" is sailing at 0915. Can you get into contact with the Docks and ascertain berthing of the Passenger Ship?
0645	Calshot Radio	Nab Pilot Cutter	I have contacted the Docks S.S. and am waiting for an answer. If it

(R) Harbour Radar Information.

Time	From	To	Message
			does not arrive before Pilot boards, ask him to listen for me on 2182 kc/s.
	Nab Pilot Cutter	Calshot Radio	Roger, I'll do that. The ship is still 2 miles away. Anything sailing from Fawley ?
	Calshot Radio	Nab Pilot Cutter	No, the "Blia" is in the Small Ship Anchorage waiting for his clearance.
	Nab Pilot Cutter	Calshot Radio	Roger.
0700	Calshot Radio	Nab Pilot Cutter	I have been in touch with the Dockmaster and the present arrangement is that the ship will have to berth between the "Queen Mary" sailing at 0915 and the "Queen Elizabeth" arriving at 1130.
	Nab Pilot Cutter	Calshot Radio	You are just too late, the Pilot has gone aboard.
	Calshot Radio	Nab Pilot Cutter	I'll try and raise her on the M.F. R/T.
0716	Tug	Calshot Radio	Any information of this ship ?
	Calshot Radio	Tug	Yes, approximate E.T.A. Netley 0900. She is going to call me shortly.
0719	Passenger Ship	Calshot Radio	The Pilot's message—"Our E.T.A. is quarter to nine at Netley and Pilot requests weather conditions."
0722	Calshot Radio	Passenger Ship	Message from the Dockmaster—"You can berth between the two Queen movements, that will put you on berth between 1030 and 1045. Vessel can berth either port or starboard side to quay.
	Passenger Ship	Calshot Radio	Message received and understood.
0732	Passenger Ship	Calshot Radio	Pilot speaking, please inform Dockmaster we are making better time than anticipated and can be at Netley by 0830, request permission to berth before "Queen Mary" sails.
	Calshot Radio	Passenger Ship	Roger—stand by.
0735	Calshot Radio	Passenger Ship	Message from Dockmaster "Berth before 'Queen Mary' sails and starboard side to quay."
	Passenger Ship	Calshot Radio	Please inform Netley Pilots I shall be at Netley at 0830 and berthing starboard side to quay. Are they agreeable ?
	Calshot Radio	Passenger Ship	Roger, Stand by. The "British Splendour" is just getting underway from Cowes Roads going to Hamble Jetty and there are two medium-sized tanker movements from Esso pending.

Time	From	To	Message
	Passenger Ship	Calshot Radio	Thank you.
0738	Calshot Radio	Passenger Ship	Netley Pilots agree to you berthing before "Queen Mary" sails.
0739	Passenger Ship	Calshot Radio	How is your visibility ?
	Calshot Radio	Passenger Ship	Visibility 2½ miles.
	Passenger Ship	Calshot Radio	You have 2½ miles, thank you. Is the "British Splendour" underway ?
	Calshot Radio	Passenger Ship	She has just got underway and is approaching Prince Consort Buoy. **(R).**
	Passenger Ship	Calshot Radio	Roger, many thanks.
0751	Passenger Ship	Calshot Radio	Are you in contact with "British Splendour" ?
	Calshot Radio	Passenger Ship	No, not in contact with "British Splendour." "Aase Maersk" passing Calshot outwards.
	Passenger Ship	Calshot Radio	Roger, thanks.
0754	Passenger Ship	Calshot Radio	The large tanker passing Gurnard Buoy, where is she bound ?
	Calshot Radio	Passenger Ship	She is going to anchor in Cowes Roads.
0820	Calshot Radio	Tug	The ship is just passing Esso Fawley.
	Tug	Calshot Radio	Thank you. We are leaving the Empress Dock now.
0852	Passenger Ship	Calshot Radio	Now on berth, thank you for your assistance. We are closing down.
	Calshot Radio	Passenger Ship	Roger, thank you.

Small Passenger Vessel — Tender to a Passenger Vessel
Coastal Tanker A — Coastal Tanker B
January, 1960

Examples of small craft not fitted with marine radar underway at the same time in the Port and its approaches in January, 1960, during variable visibility of a ½-4 cables. Only one of these vessels was equipped with V.H.F. R/T. The remaining three were equipped with M.F. R/T which they are now unable to use for communication with Calshot Signal Station.

Small Passenger Vessel:

A small Passenger Vessel approaching the entrance of the Thorn Channel, requested Calshot Signal Station for her position. To facilitate identification on the Harbour Radar display, the vessel was requested to alter course to starboard and when identified, her position was given as a bearing and distance from Bourne Gap Buoy, the first port-hand buoy marking the navigable channel. Additional information was passed regarding other vessels navigating in her vicinity and her position relative to a number of navigational marks.

Tender to a Passenger Vessel anchored in Cowes Roads:

The Tender, which was outward bound, requested Calshot Signal Station to confirm her position relative to Thorn Knoll Buoy which she anticipated was on her port bow, but Calshot Signal Station was able to inform this vessel that the buoy was on her starboard bow, that is, the Tender was outside the navigable fairway. Also the bearing and distance of the next buoy was given, enabling the Tender to alter course back to the navigable channel.

(R) Harbour Radar Information.

Coastal Tanker A:

This is an example of a small Coastal Tanker which had anchored in the Small Ship Anchorage, enquiring from Calshot Signal Station whether her berth at the Petroleum Terminal was clear before she got underway. Calshot was able to inform her that her berth was still occupied and advised her to remain at anchor.

Coastal Tanker B:

This Coastal Tanker was inward bound to anchor in the Small Ship Anchorage and requested information of her position relative to Hook Buoy which was passed by Calshot Signal Station and the Tanker was able to adjust her course accordingly. Also, Calshot informed her when she was in a good position for anchoring in order to clear the main navigable channel and other vessels already at anchor.

Time	From	To	Message
0730	Small Passenger Vessel	Calshot Radio	How am I for W. Bramble Buoy ?
0733	Calshot Radio	Small Passenger Vessel	You are alongside N.E. Gurnard Buoy. Bourne Gap Buoy bears 053°. **(R).**
	Small Passenger Vessel	Calshot Radio	No, I am alongside W. Bramble. I can't see or hear a thing. My Course is N.26° E.
	Calshot Radio	Small Passenger Vessel	I say you are alongside N.E. Gurnard Buoy, alter course to 070° so that I can identify you. **(R).**
	Small Passenger Vessel	Calshot Radio	Roger, will do.
0742	Calshot Radio	Small Passenger Vessel	I have identified you ; Bourne Gap Buoy bears 056° true. **(R).**
	Small Passenger Vessel	Calshot Radio	Thanks very much.
0744	Tender	Calshot Radio	I am passing (Fawley) oil jetties now.
	Calshot Radio	Tender	Fairway is clear except for medium sized vessel in the vicinity of No. 2 Controlled Anchorage position. **(R).**
0750	Small Passenger Vessel	Calshot Radio	How am I now ?
	Calshot Radio	Small Passenger Vessel	Bourne Gap (buoy) right ahead ½ mile. **(R).**
	Small Passenger Vessel	Calshot Radio	Roger.
0759	Calshot Radio	Small Passenger Vessel	Bourne Gap Buoy abeam now to starboard. **(R).**
	Small Passenger Vessel	Calshot Radio	Roger, how is the (Calshot Spit) Light Vessel bearing ?
	Calshot Radio	Small Passenger Vessel	Light Vessel is right ahead of you now. The Coastal Tanker B is coming across North Channel and the Tender is passing Calshot Signal Stations outwards. **(R).**
	Small Passenger Vessel	Calshot Radio	Roger.
0810	Tender	Calshot Radio	Is Thorn Knoll Buoy on my port bow please ?
	Calshot Radio	Tender	No, on your starboard bow. You are inside N. Thorn Buoy. Thorn Knoll Buoy bears 239° true. **(R).**

Fig. 4. Mosaic of the three working Radar Display areas showing the interscan method of fixing positions relative to navigational marks and other conspicuous objects in the vicinity of a vessel.

Time	From	To	Message
0814	Tender	Calshot Radio	Thank you, coming round now. I can see Thorn Knoll and the vessel I am proceeding to. The Master thanks you for your assistance.
0816	Coastal Tanker A	Calshot Radio	Has the Tanker left (the Terminal) yet ? I was supposed to take her berth at 0600.
	Calshot Radio	Coastal Tanker A	Remain at Anchor. She is still alongside owing to fog.
	Coastal Tanker A	Calshot Radio	Roger, thank you.
0817	Coastal Tanker B	Calshot Radio	What is my position please ?
	Calshot Radio	Coastal Tanker B	Hook Buoy bears 307° ½ mile. **(R).**
	Coastal Tanker B	Calshot Radio	Is there any vessel near Hook Buoy ?
	Calshot Radio	Coastal Tanker B	No, I'll tell you when you are in a good position to anchor. **(R).**
0822	Calshot Radio	Coastal Tanker B	You are in position to anchor now. **(R).**
	Coastal Tanker B	Calshot Radio	I can now see Hook Buoy. Thanks for your assistance.
0830	Small Passenger Vessel	Calshot Radio	Thank you for your assistance. I am alright now, visibility is 3 to 4 cables.

(R) Harbour Radar Information.

Medium Size Passenger Vessel—January, 1960

Example of a Medium Size Passenger Vessel, not fitted with marine radar, entering port in variable visibility, ½ to 4 cables, and bound to Berth 108/9, Southampton Docks. Radar assistance given by Calshot Signal Station and advised by the Docks Signal Station that conditions unsuitable for docking. Further radar assistance given by Calshot Signal Station for her to anchor in the Controlled Anchorage at Fawley.

Bearing and distance can be measured from Calshot Signal Station or any navigational mark or other conspicuous object in the vicinity of a vessel by the use of an electronic marker or interscan on the radar display. Bearing and distance are immediately available on counter-type dials for passing by R/T.

It is interesting to note that this movement was taking place at the same time as information was being passed to the four vessels in the previous example.

Time	From	To	Message
0644	Passenger Vessel	Calshot Radio	Calling Calshot on Channel 16.
	Calshot Radio	Passenger Vessel	Receiving you. Channel 12 please.
	Passenger Vessel	Calshot Radio	Please give my distance and bearing from Calshot.
	Calshot Radio	Passenger Vessel	178°, 2.25 miles. **(R).**
	Passenger Vessel	Calshot Radio	Roger, understood.
0650	Passenger Vessel	Calshot Radio	Distance and bearing West Bramble Buoy now.
	Calshot Radio	Passenger Vessel	328°, 3 cables — you are swinging—319°, 3 cables now. **(R).**
	Passenger Vessel	Calshot Radio	Understood, thank you.
0655	Passenger Vessel	Calshot Radio	Position of W. Bramble Buoy please ?
	Calshot Radio	Passenger Vessel	2° on your starboard bow, 1 cable. **(R).**
	Passenger Vessel	Calshot Radio	Roger, understood, will call you again later.
0700	Passenger Vessel	Calshot Radio	Bearing and distance from Bourne Gap (buoy) please ?
	Calshot Radio	Passenger Vessel	043°, 5½ cables. **(R).**
	Passenger Vessel	Calshot Radio	Roger, is anything anchored between me and Fawley ?
	Calshot Radio	Passenger Vessel	No, two ships in small ship anchorage only. Visibility here ½ mile, Docks 2 to 3 miles. **(R).**
	Passenger Vessel	Calshot Radio	Understood, will call you again later.
0713	Passenger Vessel	Calshot Radio	Position from Castle Point Buoy ?
	Calshot Radio	Passenger Vessel	330°, 3 cables. **(R).**
0715	Calshot Radio	Passenger Vessel	You are abeam Castle Point Buoy now. **(R).**
	Passenger Vessel	Calshot Radio	Roger. How does Hook Buoy bear ?
	Calshot Radio	Passenger Vessel	329°, 9½ cables. **(R).**
	Passenger Vessel	Calshot Radio	Roger, understood.
0722	Passenger Vessel	Calshot Radio	Am I abeam of Black Jack (buoy) yet ?
	Calshot Radio	Passenger Vessel	Your bow is just abeam now, Hook Buoy is right ahead. **(R).**
0726	Passenger Vessel	Calshot Radio	Position of Hook (buoy) please ?
	Calshot Radio	Passenger Vessel	Abeam distance 1 cable. **(R).**
	Passenger Vessel	Calshot Radio	Roger.

Time	From	To	Message
0730	Passenger Vessel	Calshot Radio	My position from Greenland (buoy) please ?
	Calshot Radio	Passenger Vessel	321°, 1.9 miles—Fairway clear. **(R).**
0732	Passenger Vessel	Docks S.S.	What is your visibility and inform Netley Pilots you are in touch with me.
0735	Passenger Vessel	Calshot Radio	Position of Greenland Buoy please ?
	Calshot Radio	Passenger Vessel	323°, 1.2 miles. **(R).**
0736	Docks S.S.	Passenger Vessel	Have you radar please ?
	Passenger Vessel	Docks S.S.	No radar.
	Docks S.S.	Passenger Vessel	Netley Pilots advise conditions for docking unsuitable, anchor if convenient.
0737	Passenger Vessel	Docks S.S.	Roger, will advise when anchored.
0741	Passenger Vessel	Calshot Radio	Position from Greenland Buoy now ?
	Calshot Radio	Passenger Vessel	327°, 4½ cables. **(R).**
0744	Passenger Vessel	Calshot Radio	Position of Greenland Buoy please ?
	Calshot Radio	Passenger Vessel	312°, 5 cables. **(R).**
0748	Passenger Vessel	Calshot Radio	Is my position from Greenland correct ? I think I am in the prohibited anchorage.
0749	Calshot Radio	Passenger Vessel	You are clear. Position of Greenland Buoy now 305½°, 5½ cables. **(R).**
0752	Passenger Vessel	Calshot Radio	Am I in line with Transit Beacons ? (Fawley Anchorage Transit Beacons.)
	Calshot Radio	Passenger Vessel	Yes. **(R).**
	Passenger Vessel	Docks S.S.	Visibility now please ?
	Docks S.S.	Passenger Vessel	½ cable only.
0802	Passenger Ship	Calshot Radio	Give me my position from Calshot please ?
	Calshot Radio	Passenger Vessel	332°, 1.4 miles. Greenland (Buoy) bears from you 320°, 9.5 cables. **(R).**
0807	Passenger Vessel	Calshot Radio	I am now anchored. Position from Calshot please ?
	Calshot Radio	Passenger Vessel	329°, 1.38 miles. No other vessel in vicinity moving until fog clears. **(R).**
	Passenger Vessel	Calshot Radio	All understood. Thank you very much.

Further Improvement Schemes for Port of Belfast

The Belfast Harbour Commissioners have recently announced further improvement schemes which will cost approximately £8 million. These include an oil jetty, for the British Petroleum Company's refinery which is being built at Sydenham, and five new wharves. Work on one of these in the Victoria Channel, for which the necessary authority has already been granted, is expected to start early this year, and it is hoped that construction of a second which is to handle the discharge of raw materials for a new fertiliser factory will be under way by July next. Work on the oil jetty has already started.

The Harbour Board intends deepening a stretch of the Victoria Channel connecting the docks with the Lough in order to facilitate the passage of large tankers, and to improve Donegall Quay for handling modern traffic.

Pneumatic Rubber Fenders

A New Development in the Transfer of Oil Cargoes in Unsheltered Waters*

Circumstances may arise in tanker operations which make it necessary to carry out a direct ship-to-ship transfer of oil cargo and where the handling of a high flash product is involved there is no great objection to this operation provided it is carried out in sheltered waters and adequate fendering between the vessels is supplied. In this case the main risk involved is damage from collision when one vessel proceeds alongside another, but ships can damage each other when lying alongside if fendering is inadequate.

A good example of high flash ship-to-ship transfer has been the bunkering trade in the Bay of Gibraltar where, through lack of space, no tankage ashore could be built and, for many years, ships proceeded alongside hulks anchored in the Bay to receive their fuel oil and gas oil bunkers, loaded tankers went alongside the hulks to replenish them. These operations have been carried out without any serious damage being sustained by either the hulks, the tankers or the customers' vessels.

More serious risks are involved when it is necessary to pump a low flash product directly from one ship to another moored alongside her and care has always been necessary to ensure that such an operation is safe; nevertheless it has been done on many occasions.

The reason for concern in carrying out ship-to-ship transfer of low flash cargo is that, apart from risk of collision damage, the far more serious risks of explosions are involved, not only during the manœuvre of bringing one vessel alongside the other and casting off after completion due to static electrical discharge, but also during the cargo transfer itself when the discharging vessel has to maintain boiler fires for operating the pumps, whilst on the loading vessel inflammable vapours are expelled from ullage plugs, sighting ports and the vapour line, and ship-to-ship contact could cause an ignition spark.

Therefore the ship-to-ship transfer of low flash cargo has never been an entirely satisfactory practice due to these danger factors. The safest method of discharging a tanker has been inside a petroleum dock especially constructed for the purpose. This is also in all cases most desirable for commercial reasons.

However, the general trend in post-war years of building larger and larger crude carriers created serious problems in providing suitable terminals for deep drafted vessels in many parts of the world. Such facilities however are limited due to geographical position and exorbitant cost of construction.

Even when the approaches and the berths are dredged to a suitable depth to accept these vessels initially, rapid siltation may render the berth or the approaches unsuitable for accepting these vessels on a full draft, which may call for emergency measures.

To cope with such situations it would be rather a simple solution if the deep drafted crude carrier could be lightened outside the port to a draft on which she could safely enter the port. There is the disadvantage however that it is not always possible to find a sheltered position on the coast in the vicinity of a temporarily restricted port where, with existing fendering equipment, a lightening operation could be carried out with safety under all weather conditions.

In a semi-sheltered bay even with a wind force as low as 4 or 5, sea and swell conditions may make it impossible to carry out a ship-to-ship transfer unless some means could be found whereby the ships could be maintained at a safe distance apart without risk of damage, and this brought to mind that for many years whale factory ships have used dead whales as fenders between ships to allow transport tankers to lie alongside and discharge bunkers and reload whale oil in a direct ship-to-ship transfer.

Experience has shown that these transfers can be made in the rough weather conditions prevalent in the Antarctic Ocean without damage being sustained by either vessel, demonstrating the efficiency of a dead whale as a fender with high shock absorbing properties.

The foregoing considerations led to an investigation into the possibility of a manufactured fender which would have the same dimensions and shock absorbing properties as a dead whale, and a number of the major rubber companies were approached with a request to investigate the matter.

It was found that it would have been possible to produce a rubber bag or tank which could be inflated and would act as a fender relying on air pressure. It was thought, however, that a fender of this design would be too vulnerable as it would lose its shock absorbing properties by a simple puncture and this would be bound to happen when compressed between two ships or when rubbing against the hulls whilst the vessels were moving in a seaway, unless the skin could be made extremely thick.

An alternative considered was an outer skin of terylene reinforced neoprene which would be fabricated in strakes and either riveted or bolted together. This outer skin would be packed with rolled natural sponge rubber of fairly high density. The whole would be shaped as a cylinder 45-ft. overall length and 15-ft. in diameter having conical ends.

The anticipated weight of such a synthetic whale would be 85 to 90 tons and the cost in the region of £70,000. The fender would absorb an impact of 2,000 inch/tons under maximum permissible compression.

This idea was not adopted for two reasons. Firstly the cost was very high and, secondly, its great weight would prevent it from being hoisted out of the water with ordinary gear should the fender have to be carried on board a lightening vessel.

Development of the Pneumatic Rubber Tyre Fender

Shell Tankers Ltd. discussed this problem with Marine Craft Constructors Ltd. and it was agreed that during refuelling, transfer of cargoes, loading in open waters, or in any other position, the tankers had to be kept at a minimum distance of 9-ft. to 10-ft. apart. The manufacturers established that such distances could, in fact, be achieved by the use of giant tyres incorporated in a unit, a model of which they were prepared to design and construct in the first instance for approval.

After further discussions on this problem, it was agreed that Marine Craft Constructors Ltd. would make up and submit such models for consideration by Shell Tankers Ltd.

In due course, two models were submitted. The first model had six tyres mounted on rims which were immovably fixed at the centre tube and this was submitted to show that it was impracticable to use a fixed unit. The second model of similar construction had each individual tyre mounted on a revolving hub and spaced equidistant on the centre tube but each rim could revolve freely on its own accord.

*Abstracts from a Report issued by the Shell International Petroleum Co. Ltd., London.

In order to demonstrate to Shell Tankers Ltd. the difference between the practicability of the two models, two boards were made available representing the sides of two vessels laying alongside each other and these were rotated in different directions. With the first model it was evident that it could not function due to tear and friction on individual units owing to their immobility but with the second model both board sections moved freely in all directions without any evidence of friction.

An order was placed by Shell Tankers Ltd. with Marine Craft Constructors Ltd. to construct two units each approximately 40-ft. overall, fitted with 10-ft. diameter tyres, each mounted on individual hubs equidistant on the central unit. Application for full patent cover was lodged with the principle maritime countries.

Marine Craft Constructors Ltd. approached various rubber companies and were advised by Firestone Tyre and Rubber Co. Ltd. that they manufactured at one of their plants in the U.S.A. tyres of 114-in. in diameter used for earth moving equipment. This was the largest diameter tyre available in the world at the time, and it was finally decided to use these tyres as shock absorbers on the principle of the second model.

Firestone had calculated that each tyre at a maximum deflection of 18-in. could absorb an impact of 200 tons. The tyres should be maintained at an air pressure of 50 lb./p.s.i., whilst the pressure should never be allowed to fall below 26 lb./p.s.i.

After consultation between Shell Tankers, Marine Craft Constructors and Firestone Company, it was decided that in order to keep the weights within practical limits and to cut down cost, the number of tyres should be reduced to 5 per fender. The total weight of the fender would then be 18 tons.

These fenders were delivered to Heysham Harbour in April 1960.

Selection of Testing Site

Heysham was selected for the trials as it was thought that the use of these fenders in this area might be economically attractive because it would provide a method for lightening crude carriers programmed for the Queen Elizabeth II Dock at Eastham where crude carriers were unable to enter on a full draft except on Spring Tides. Secondly, it would provide a means whereby the crude for the Heysham refinery could be freighted in crude carriers, the idea being that an incoming crude ship of 33,000 tons would anchor 11 miles out in the Lune Deeps in Morecambe Bay and, to allow her to get into the Queen Elizabeth II Dock, would transfer sufficient cargo into a lightening ship, which in turn could discharge either at Heysham or in the Queen Elizabeth Dock whatever would be required.

Thirdly the Port of Heysham offered facilities for keeping the fenders safely moored in the harbour during the time they were not in use and, when required, they could be towed out of the harbour by a tug and brought alongside the crude carrier anchored in the Lune Deeps.

A programme was arranged of directing 33,000 tonners to the Lune Deeps for lightening prior to proceeding to the Queen Elizabeth II Dock and also make available the necessary vessels

(left). First contact of S.T.S. *Halia* with forward fender.
(above). Showing position of *Halia* after first contact with forward fender, and the aftership coming to rest against the fender.

which would act as lightening vessels and discharge either at Heysham or Stanlow.

Testing of the Fenders

The first vessel nominated for lightening in the Lune Deeps was the *San Gaspar*, a vessel of 32,000 tons deadweight; the vessel nominated as lightening ship was the 18,000 tons deadweight *Halia*.

On 28th April 1960 the *San Gaspar* anchored at 9.20 a.m. in the Lune Deeps and at 9.30 a.m. the fenders were towed alongside her starboard side and secured by the forward pendant. The 60-ft. wires between the fenders were then disconnected and the fenders were spaced independently, some 200-ft. apart, one just abaft the break of the foc'sle head and the other some 40-ft. forward of the break of the poop. In this position they would be correctly placed to cover the straight side of the *Halia*, when she would be moored alongside with the manifolds of both vessels

opposite each other.

The fenders were securely moored in the above-mentioned position at 11.00 a.m. and at 11.15 a.m. the *Halia* came alongside assisted by the two tugs who brought the fenders.

The first impact was made when the *Halia* came alongside the *San Gaspar* on the forward fender and, although she landed rather heavily, the fender absorbed the initial shock smoothly on two of the most forward tyres which were compressed by about 6-in.

Due to the speed and angle of approach the *Halia* bounced off some 10-ft., swung and then contacted the other fender which also absorbed the impact smoothly without any feeling of shock or tremor. The *Halia* was then moored fore and aft in the normal manner with the fenders keeping the vessels 10-ft. apart.

On this occasion the weather was calm without any sea or swell. There was, however, a strong tide running but the entire manœuvre of coming alongside was carried out without any difficulty.

The vessels lay quietly alongside from 11.00 a.m. on the 28th April 1960 until 9.00 a.m. on the 29th April 1960, during which time the *Halia* discharged her ballast and loaded a cargo of some 16,600 tons Kuwait crude from the *San Gaspar* at an average loading rate of some 1,790 tons per hour.

Although the fenders showed their efficiency during the above operation and did not leave any doubt that a ship-to-ship transfer could be carried out with safety in calm weather no conclusions could be drawn as to what their behaviour would be during rough weather. A series of 13 further tests was therefore carried out. With the exception of Nos. 5 and 13, all these were uneventful and equally as successful as the first.

Tests Nos. 5 and 13, however, were of more particular value as the weather deteriorated during the operations and some important information was obtained. Test No. 5 was carried out under moderate weather conditions, but the weather worsened whilst lightening the oil carrier *Chelwood Beacon* during the night of the 26th May 1960.

To save time, and to enable the *Horomya* (the lightening vessel) to go alongside the *Chelwood Beacon* before nightfall, it was suggested to the pilot that the fenders should be secured alongside the *Horomya* so that she could proceed alongside the *Chelwood Beacon* without delay, instead of waiting for the fenders to be transferred to the *Chelwood Beacon* by the tugs.

The pilot agreed to this and the *Horomya*, with the fenders towing alongside her portside in the correct position, went alongside the *Chelwood Beacon* without any difficulty. She steered and handled well and those in charge considered that this procedure of keeping the fenders alongside the lightening craft is to be preferred, and it was followed on several subsequent occasions; there appears to be less likelihood of damage and the lightening craft is able to manœuvre in such a manner that the fenders always make the first contact with the other vessel.

Whilst lightening of the *Chelwood Beacon* was in progress the weather conditions deteriorated, the wind being moderate to fresh W.S.W. with occasional strong gusts. Due to the influence of the wind and a strong tide, a steep sea was set up between the two vessels. The tide forced the vessels some 15-ft. apart, allowing the fenders to move freely up and down in the sea and their vertical movement was estimated to be from 6 to 8-ft.

Consequently at times the fenders gave sudden and sharp pulls on their forward securing wires. This jerking on the wires caused anxiety and it was obvious that if this motion should be sustained the wire would part eventually. The forward fender was therefore slacked back as far as possible, and while this did not stop the jerking it did improve the situation and the wire stood up to the strain until the lightening operation was completed.

During test No. 13, which was also conducted during adverse weather, the wire did part however and it is worth recording this test in more detail.

Tests Nos. 12 and 13 were carried out on the 7th to 8th June.

The fenders were secured alongside oil carrier *San Gaspar* and the *Helix* (lightening vessel) was moored alongside at 0615 hours 7th June without incident. The weather was fair but deteriorating, and by 9.00 a.m. the fenders were plunging heavily in a moderate swell and snatching at the securing wire under the influence of a tide running at over 3 knots. A rough sea and moderate to heavy swell was running and the wind had increased to 30 miles per hour, which is equal to force 7 of the Beaufort scale, being a moderate gale.

Due to the heavy surging and stretching, it was found necessary to borrow two towing springs from the *Helix*, each consisting of 60-ft. x 7-in. nylon rope and 200-ft. x $3\frac{1}{2}$-in. circ. wire. One of these springs was attached to the forward end of each fender by securing it between the first and second tyre around the centre tube, the other end being secured to the ship and these springs replaced the $4\frac{1}{2}$-in. wires.

The lightening of the *San Gaspar* was completed at 14.00 hours and the *Helix* unmoored and, towing the fenders alongside, moved over to the oil carrier *Bergesund* at 19.00 during a lull in the weather conditions.

The lightening of the *Bergesund* was completed at 00.40 on the 8th June and throughout the night the weather conditions were bad. There was a rough sea with the wind up to gale force 8.

The fenders were subjected to a great deal of buffeting but they stood up to it well and no undue strain was observed on the nylon pendants.

Conclusions

The tests carried out so far have shown that the fenders themselves are suitable for the purpose for which they are designed and that by using them lightening operations can be carried out even in unsheltered waters in bad weather conditions.

It will be appreciated however that their use is limited to a certain extent. They would not give adequate protection for instance in the open sea during a gale when a heavy swell was running in excess of force 8.

Their use under these circumstances would be limited to coastal waters and in semi-sheltered bays where the vessels moored alongside each other would not be subject to heavy pitching and rolling. In any case it would be impossible to moor ships alongside each other under these latter circumstances as the mooring lines between vessels would part.

Therefore, if circumstances call for the use of these fenders each case must be considered on its merits. Also, it has to be borne in mind that lightening of vessels is a costly operation and the economic factors have to be assessed before lightening is undertaken. Places that might be considered for future use of the fenders may be Karachi, in Nigeria (outside Bonny River Bar) and at the entrance to the River Plate where it is thought the fenders could be used successfully.

During the trials the fenders proved to be ideal shock absorbers and although the present units have 5 tyres, the tests have indicated that with 4 tyres the fenders would work equally well.

The tests have also shown that the fenders can be transported in various ways without much difficulty.

(a) They can be towed out of the harbour by a tug being taken on a tow line in tandem.
(b) The tug can tow them alongside one fender on each quarter.
(c) The lightening ships can tow them alongside and some of the pilots have preferred this when proceeding alongside the vessel to be lightened.
(d) They can also be towed behind the lightening vessel and,

Pneumatic Rubber Fenders—continued

when required, can be pulled alongside before contacting the vessel to be lightened.

As the fender throughout protracted trials and under adverse conditions has proved an ideal shock absorber, it is obvious that the same principles can be applied for use in ports and harbours to prevent ships damaging port installations and also damage between themselves. To enable a number of vessels of any tonnage to lie moored alongside each other in perfect safety, other units have been designed for incorporating in harbour works, entrances to docks etc. In many instances these should obviate the necessity for the installation of continuous fixed fendering throughout the length of harbours and jetties.

A separate company is at present being formed to deal solely with the production of types of fendering incorporated under the provisional patent already granted and for which full patent right application has been already lodged with the principal maritime countries.

Manufacturers' Announcements

Grab Dredger for British Waterways, Northern District

A grab dredger, which is to be used for maintaining the waterways in the North Eastern Division of British Waterways, was delivered last month by J. S. Watson (Gainsborough) Ltd. The vessel, which is 61-ft. in length by 15-ft. in width and with a depth of 5-ft., is of all welded steel construction and is powered with a Lister Blackstone 30 h.p. air cooled diesel engine. A 2-4 ton Jones Crane is fitted forward and two Priestman grabs, one of $\frac{1}{2}$ cu. yd. and one of $\frac{1}{4}$ cu. yd. capacity have been supplied for use with the crane. Steel fendering is fitted all round the vessel to minimise damage from contact with locks, other craft, etc.

Maintenance Crane Boat under way during trials on the River Trent.

Steering and engine controls and a small cabin are sited aft. A hold amidships with a grano-concrete bottom surface is for carrying spoil and items of maintenance equipment. Its hard surface is to give the bottom protection from damage by the crane grabs.

This Maintenance Crane Boat will be based at the Goole repair depot and is to be put into use immediately.

Manufacture of Ellicott Dredging Equipment in the U.K.

Stothert and Pitt Ltd. of Bath, have announced that they have entered into an agreement with Ellicott Machine Corporation of Baltimore, U.S.A., for the manufacture, under license in the United Kingdom, of dredges and dredging machinery of all sizes and types in accordance with Ellicott designs and specifications.

Stothert and Pitt, a company well known throughout the world for its dockside cranes, has also for many years been engaged in the manufacture of multi-bucket excavators; deck machinery for ships, including windlasses, capstans, winches and deck cranes; contractor's plant for road-making; various kinds of pumps; and other heavy engineering products. They are represented throughout Great Britain and in many overseas countries.

As far as sales are concerned, Ellicott Machine Corporation have arranged to be represented in the United Kingdom by John Blackwood Hodge and Co. Ltd., London and Northampton, who are the parent organisation of a world-wide group of companies specialising in the sale distribution, repair and maintenance of capital equipment required by the earth-moving and civil engineering industries. Ellicott is represented by other Blackwood Hodge companies in Australia, India, Pakistan, Rhodesia and Nigeria.

Ellicott Machine Corporation was established 75 years ago and is exclusively engaged in the designing and building of dredges of all types and sizes. In addition to its main plant in Baltimore, a second plant manufactures dredge hulls, as well as tanks and other pressure vessels, hot water generators and heat transfer equipment; while a third plant manufactures sheet steel products, formings, stampings and weldments; and a steel foundry in Pittsburgh, produces a wide range of industrial castings and railroad specialities.

In Canada, an affiliate, Timberland-Ellicott Limited at Woodstock, Ontario, manufactures the complete line of Ellicott dredges and, in addition, special machinery for logging, construction and marine industries. There are also affiliates in France, Brazil and Mexico, as well as licensing arrangements in certain other countries.

Ellicott dredges are used for river and harbour improvement, the filling of marsh land for the improvement of industrial and residential purposes, the digging of rivers and canals for navigation purposes, and for drainage and irrigation. They are now at work in more than thirty countries throughout the world.

Flowfreight Multiple Deck System

It is claimed that the export of motor cars could be considerably speeded up by an invention of Fisher and Ludlow Ltd. (Material Handling Division), Birmingham. This consists of tiers of open steel " hanging decks " which can be lowered in a ship's hold to carry 1,000 cars, and then quickly hoisted out of the way at the port of arrival to make room for a different return cargo. The whole series of false decks can be dismounted within one day by a ship's crew—even after the ship has put to sea again. At present, cars are generally carried on tubular steel scaffolding with timber stretched across it an unwieldy system which takes five to eight days to dismantle after the cars have been unloaded.

Description of System

The decks of open steel gratings hang one beneath another in the hold, six feet apart, on chains or on hawsers. There may be three or four of these decks, depending on the depth of the hold. The cars are lashed down on them. When they have been unloaded, it is an easy matter—using the ship's winding gear—to hoist the deck frames up into the ship's overhead (the top of the hold). There they are clamped into position by stowage brackets, leaving the hold clear for other cargo. When stowed, three decks take up a space only 21-in. deep.

When the decks are lowered there is no complicated clamping and bracketing to be done. The decks do not hang free, but run up and down in channels utilising guide brackets. The edge of each deck frame is fitted with a bracket, and the use of wedges makes the whole structure rigid. The decks will rise easily even when the ship is rolling at an angle of 20 degrees.

In the hatch openings, the panel units are supported by readily demountable steel work and half of the opening is left clear to enable the cars to be loaded on to the several decks. As loading proceeds and each deck is filled, the open area is covered by further deck panels on to which the cars are then loaded. Additionally, a small deck can also be hung in the upper hatch square to enable sports cars to be stored directly under the hatch covers; thus, all available space is effectively utilised.

After unloading, the deck units in the hatch openings can be hoisted by the ship's derricks and lashed down on the main deck, or alternatively they can be made in units of suitable sizes to

enable them to be placed on the hanging decks on the sides of the hatch openings so that they can be hoisted with the hanging decks for stowage at the top of the ship's holds. Further, when the return cargo is grain, the centre panels can be fitted vertically between the bulk heads and round the hatch openings, and covered with light gauge steel sheet to form grain shifting boards and feeders, which must be fitted in any case to prevent the cargo of grain shifting from one side of the hold to the other.

When carrying grain, the rest of the hanging decking can be left in position, as the grain passes freely through the gratings—even whiskery grain like barley.

The new system would give a quicker turnround of ships and lower demurrage charges and it has wider application for general cargo, achieving as it does a maximum usage of hold space. In addition, more cars per hold can be carried, 1,000 in a 13,000 ton ship, for instance, which is 200 or 20 per cent more than by using scaffolding and planking.

The system has already been installed in the 13,500-ton Norwegian merchant ship "Ingwi" which is being refitted at the Deutsche Werft shipyard of Hamburg to carry cars to North America and probably return with grain. Two further contracts have been secured from Norwegian shipowners, two from the Netherlands and a modified version of the system has been fitted to the Bristol City Line's steamer "New York City." This Carflow system has received Lloyd's approval, and the manufacturers expect to receive soon the approval of the Ministry of Transport also. It is believed that the system should also have a wider application for general cargo to promote maximum usage of any hold by using one, two or even three decks.

The Cargon Freighting System

Another materials handling device developed by this Company is the Cargon freighting system. In effect this is a mobile vehicle deck mounted on wheels permitting it to be rolled on or off a vehicle in seconds. Empty Cargons in warehouses or at the end of production lines can be loaded in advance of delivery and so be ready to be rolled on to the vehicle, thus cutting turnround time. For moving the Cargons transversely, the Company provide a mobile trolley and this gives the system greater flexibility when loading.

Freight Nets of Slotted Nylon Tapes

Freight nets are being made of woven nylon webbing, with slots woven laterally in the webbing. A net is made up by passing the webs through each other vertically and horizontally; this prevents any weakening of the tapes at intersection, and there is no splicing, as in ropes, or stitching, as in canvas. The slots are spaced at frequent intervals throughout the length of the webbing, so that close or open mesh can be produced as required.

Weight for weight, these slotted nets are much stronger than conventional cargo nets. Since nylon does not absorb water, they do not become heavier or intractable when wet. They are also not liable to rot.

Although developed originally for use by the Services, these nets should have many applications for civilian purposes, e.g. in handling meat or other food-stuffs. They can be made up square or rectangular, in sizes up to 50-ft. square. The manufacturers are Thomas French & Sons Ltd., Manchester 15.

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